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WIELDING THE SWORD WHILE FORGING THE SHIELD: NUCLEAR, BIOLOGICAL, CHEMICAL AND MISSILE COUNTERFORCE OPERATIONS

by

Timothy F. Lindemann, Lt Col, USAF

Advisor: Lt Col Robert Allgood, Jr.

Maxwell Air Force Base, Alabama

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Disclaimer

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Preface

This research paper was prepared during my year at The Washington Institute for Near East Policy as a National Defense Fellow. During this time, The Washington Institute staff encouraged me to turn my attention to one of the most acute security issues of the Middle East region—weapons of mass destruction and the theater ballistic missiles that could be used for their delivery. The staff also sensitized me to the need for an informed (unclassified) discussion of U.S. military capabilities to deal with these weapons and the challenges associated with the employment of such capabilities.

I gratefully acknowledge the assistance of a number of individuals representing the organizations cited in the text and notes, who are too numerous to list in this limited space. Readers should rest assured that highly competent, experienced, and dedicated individuals are examining, if not addressing, the issues raised in this paper. These individuals, however, would not necessarily completely agree with me on the need for this or that specific action; nor are established priorities and existing budgetary resources, in my judgment, particularly conducive to these individuals' success.

A special note of appreciation goes to Michael Eisenstadt at the Washington Institute, who has served as an advisor and close colleague during this year. His guidance and support have been essential to this project, from inception to completion.

Abstract

This paper argues that an immediate conceptual focus on and resource commitment to nuclear, biological, and chemical weapons and theater missile (NBC/M) counterforce is essential to preserving the ability of the U.S. to project military power and successfully prosecute operations in the near- to mid-term (through 2005-2015). An immediate focus and commitment are essential because the potential contributions of NBC/M counterforce operations remain poorly understood and undervalued, as does the urgent need for NBC/M counterforce capabilities. This paper examines the potential roles and contributions that NBC/M counterforce could make, the inadequacies of our current NBC/M counterforce approach, and the urgency of the need for NBC/M counterforce capabilities. It surveys the NBC/M threat that deployed U.S. forces face—using the Middle East as a regional context, since this region presents a particularly troublesome NBC/M case and a likely area for U.S. operations. Using the most current and available data, this paper examines the U.S. Theater Missile Defense shield—the active defense Family of Systems—and assesses the likelihood of a fielding of adequate active defense capabilities in the near- to mid-term. It reviews and assesses developments in NBC/M counterforce over the past decade, highlighting: operational challenges planners face; areas in which there have been improvements in capabilities; and areas in which capability gaps persist. The paper closes with some recommendations for improving NBC/M counterforce operational capabilities in the near- to mid-term.

Chapter 1

The NBC/M Strategic Context

> *U.S. conventional military superiority paradoxically creates an incentive for adversary states to acquire NBC weapons. Because our potential adversaries know that they cannot win a conventional war against us, they are more likely to try asymmetric methods such as employing biological or chemical weapons or threatening the use of nuclear weapons.*[1]
>
> —U.S. Secretary of Defense William Cohen, January 2001

During this past year, the American public has witnessed the publication of a remarkable number of defense and security policy studies that were undertaken in preparation for the Congressionally mandated 2001 Quadrennial Defense Review and in anticipation of the policy reviews the new presidential administration would conduct. Despite the diversity in study topics and study group compositions, these studies reflect two unifying themes. First, nuclear, chemical, and biological (NBC) weapons and their means of delivery represent the greatest direct threat to U.S. national interests. Second, the U.S. military must be prepared both to defend the United States homeland from NBC attacks and missile attacks, and—more relevant to the purpose at hand—to conduct operations abroad under the threat of or actual employment of NBC weapons and theater missiles.[2]

These studies echo many of the same broad objectives, timing, and targets for NBC attack that are contained in current U.S. military doctrine and contemporary discussions of NBC operations. They foresee the use of NBC attacks by adversaries early in a crisis or conflict to intimidate neighbors, deter U.S. intervention, and disrupt a U.S. led coalition. They also foresee the possible use of NBC weapons mid-war to prevent a catastrophic defeat, or late in the conflict to ensure regime survival or to seek revenge. An objective to which the new studies ascribe greater emphasis though, is an adversary's use of NBC weapons early in the conflict—during the U.S. deployment phase—as part of an anti-access strategy.[3]

Anti-access strategies would seek to prevent or disrupt the buildup of U.S. forces in the theater of conflict by denying physical access to critical bases, ports, and or other essential logistical or operational facilities.[4] The denial of such facilities, even if temporary, could limit both the absolute volume of combat power that the U.S. could bring to bear against an adversary—by reducing or delaying the arrival of theater-based forces—as well as the timing of U.S. combat power deployment. Given the limited forward deployments of U.S. forces around the globe and the logistical complexity of moving large volumes of men and equipment great distances from the U.S., a successful anti-access strategy would lead to disruptions in planning and a limitation of the military options available to the U.S. theater commander.[5]

Anti-access strategies would not require the most advanced modern weapons to execute. Quiet conventional (diesel-powered) submarines, anti-shipping cruise missiles, and sea mines could be quite effective in disrupting the in-theater sea lines of communication and in denying access to port facilities. With guidance and control improvements that are currently being marketed for Scud-type missiles, salvo launches of theater ballistic missiles with cratering munitions could be effective in suppressing airbase sortie generation and closing down flight operations.[6] The older biological and chemical weapons and delivery systems that predominate in the existing inventories of potential adversaries are also likely to figure prominently in anti-access strategies, for while the objective is to inflict military casualties and to create disruption, mass casualties would not be necessary to achieve this objective and may not be desirable.[7] Some adversaries will seek to prevent the "Pearl Harbor" syndrome—the arousal of a U.S. military giant, supported by a unified and supportive public.[8]

Service planners recognize that the attractiveness of anti-access strategies is growing, as is the threat to U.S. power projection capabilities. To varying degrees, the military services have sought to address anti-access operations in their long-range plans and operational concepts. The U.S. Army (and Marines), although viewing anti-access operations as yet just another obstacle to be overcome on the way to the main objective in the conflict, is transforming itself into a lighter, leaner force that will be able to deploy more quickly and with a substantially reduced logistical footprint in theater. The U.S. Navy is emphasizing "assured access" activities—the defeat of area denial threats such as mines and anti-shipping cruise missiles, as it focuses more on power projection ashore from littoral areas and less on blue-water, deep ocean activities. The U.S. Air Force has reinvigorated its "Global Reconnaissance Strike" concept—an aerospace power projection concept designed to meet both the compressed time demands of modern warfare and the anti-access challenge.[9]

The U.S. Air Force concept for dealing with nuclear, biological, and chemical weapons and theater missiles (NBC/M)—the fundamental anti-access challenge—and how well the Air Force is preparing itself to implement this concept warrants particular attention for three reasons. First, as noted by both the U.S. Department of Defense (DoD) and Congress' Government Accounting Office, the Air Force has led the other Services in formulating an approach for developing and providing the military capabilities to counter NBC/M proliferation.[10] Moreover, the Air Force has endeavored to bring "more of a counterforce approach to the counterproliferation equation" and "work on the operational challenges."[11] Second, the use of military force to deal with NBC/M, as illustrated by the anti-access challenge, is fundamentally (but by no means exclusively) an aerospace intelligence surveillance and reconnaissance (ISR) and precision deep-attack issue.[12] Third, in recognition of these two points, the Joint Staff has designated the Air Force as the lead service for counterforce doctrine, concepts, and requirements development.

U.S. Air Force concepts such as Global Reconnaissance Strike recognize that NBC/M counterforce operations—offensive military actions aimed at denying, degrading, or destroying an adversary's nuclear, chemical, and biological weapons and theater missile capabilities—will be an essential component of future joint operations. Global Reconnaissance Strike envisions U.S. strike forces—primarily long-range bombers and sea based missiles, supported by a smaller theater-based force of fighters and unmanned combat aerial vehicles (UCAVs)—neutralizing the anti-access threat, thereby enabling the safe further deployment of U.S. forces. Neutralization of the anti-access threat will require both "counter-Weapons of Mass Destruction (WMD)" and "counter-cruise/ballistic missile operations."[13] In fact, some U.S. Air Force planners have gone so far as to suggest that the counter-missile operations even may need to precede suppression/destruction of enemy air defenses (SEAD/DEAD) operations during the first phase of a military operation.[14]

This proposition regarding the timing of "counter-missile operations," in conjunction with the thoughts from the defense studies and service concepts of operation that this section has introduced, are reassuring signals for the further development of NBC/M counterforce capabilities. Such reassurance is indispensable, for while some progress has been made in the decade that has passed since the U.S. military's first brush with the post-Cold War NBC/M threat in Operation DESERT STORM, significant challenges remain.[15] Meeting these challenges will require an immediate conceptual focus on and commitment of resources to NBC/M counterforce that the U.S. military has been unable to generate in light of the supereminence of NBC/M defensive programs and service-internal budgetary priorities.

This paper argues that such an immediate conceptual focus on and resource commitment to NBC/M counterforce is essential to preserving the ability of the U.S. to project military power and successfully prosecute operations in the near- to mid-term (through 2005-2015). An immediate focus and commitment are essential because the potential contributions of NBC/M counterforce operations remain poorly understood and undervalued, as does the urgent need for NBC/M counterforce capabilities. The next chapter (Chapter 2) will examine further the potential roles and contributions that NBC/M counterforce could make and highlight the inadequacies of our current NBC/M counterforce approach. Chapters 3 and 4 will address the urgency of the need: Chapter 3 surveys the NBC/M threat that deployed U.S. forces face[16]—using the Middle East as a regional context, since this region presents a particularly troublesome NBC/M case and a likely area for U.S. operations; Chapter 4, using the most current and available data, examines the U.S. Theater Missile Defense (TMD) shield—the active defense "Family of Systems" (FoS), and assesses the likelihood of a fielding of adequate active defense capabilities in the near- to mid-term. Chapter 5 will review and assess developments in NBC/M counterforce over the past decade, highlighting: operational challenges planners face; areas in which there have been improvements in capabilities; and areas in which capability gaps persist. The paper will then close with some recommendations on improving NBC/M counterforce operational capabilities in the near- to mid-term (Chapter 6) and a brief summary (Chapter 7).

Notes

[1] U.S. Department of Defense, Office of the Secretary of Defense, *Proliferation: Threat and Response* (Washington, D.C: GPO, January 2001), on-line, internet, January 11, 2001, available from http://www.defenselink.mil/pubs/ptr20010110.pdf.

[2] Commission on America's National Interests, *America's National Interests: A Report from the Commission on America's National Interests*, July 2000, on-line, internet, 20 October 2000, available from http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/Nat-Interest2; United States Commission on National Security 21st Century, "Seeking a National Strategy: A Concert for Preserving Security and Promoting Freedom," April 15, 2000, on-line, internet, 10 September 2000, available from http://www.nssg.gov/PhaseII.pdf; and Quadrennial Defense Review 2001 Working Group, "Report of the National Defense University Quadrennial Defense Review 2001 Working Group" (Washington, D.C.: Institute for National Strategic Studies, National Defense University, November, 2000).

[3] In addition to the Quadrennial Review 2001 Working Group report, see Sam J. Tangredi, "All Possible Wars? Toward a Consensus View of the Future Security Environment, 2001-2025," McNair Paper no. 63 (Washington, D.C.: Institute for National Strategic Studies, National Defense University, November 2000) and Kenneth F. McKenzie, Jr., "The Revenge of the Melians: Asymmetric Threats and the Next QDR," McNair Paper no. 62 (Washington, D.C.: Institute for National Strategic Studies, National Defense University, November 2000). For current U.S. doctrine, see U.S. Department of Defense, Joint Chiefs of Staff, *Joint Doctrine for Operations in Nuclear*, *Biological*, *and Chemical (NBC) Environments*, Joint Pub 3-11, 11 July 2000 (Washington, D.C.: GPO, 2000).

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[4] Adversaries may also attempt to deny U.S. forces access to space and information as part of anti-access strategies, but these areas will not receive attention here.

[5] On access denial strategies, see the discussions in Tangredi and McKenzie.

[6] Scud missiles have a 2km Circular Error Probable (CEP). The Russians have developed and are marketing an optical seeker for Scud-type missiles (warheads) that in conjunction with the addition of lattice fins (allowing the warhead to maneuver), would reduce CEP to 30-40m. CEP is "an indicator of the delivery accuracy of a weapon system, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of a missile's projectiles are expected to fall." U.S. Department of Defense, Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02, 23 March 1994 (As Amended Through 1 September 2000) (Washington, D.C.: GPO, 2000). On Scud accuracy, see Dennis M. Gormley and Scott McMahon, "Proliferation of Land-Attack Cruise Missiles: Prospects and Policy Implications," in *Fighting Proliferation: New Concerns for the Nineties*, ed. Henry Sokolski (Maxwell AFB, AL: Air University Press, 1996), p. 161. On potential Scud accuracy enhancements, see Douglas Barrie and Simon Sardzhyan, "Russian Seeker Sale May Undermine MTCR," *Defense News*, March 26, 2001, p. 1, on-line, internet, March 26, 2001, available from http://ebird.dtic.mil/Mar2001/s20010326seeker.htm. On the use of conventional weapons as part of anti-access strategies, see David G. Blair, "Consequences of the Spread of Weapons of Precise Destruction," in *Pulling Back From the Brink: Reducing and Countering Nuclear Threats*, eds. Barry R. Schneider and William L. Dowdy (Portland, OR: Frank Cass, 1998), p. 286 and David Blair, "How to Defeat the United States: The Operational Military Effects of the Proliferation of Weapons of Precise Destruction," in *Fighting Proliferation: New Concerns for the Nineties*, ed. Henry Sokolski (Maxwell AFB, AL: Air University Press, 1996), pp. 75-94.

[7] On chemical and biological weapons use as part of anti-access strategies, see Greg Weaver and J. David Glaes, *Inviting Disaster: How Weapons of Mass Destruction Undermine U.S. Strategy for Projecting Military Power* (McLean, VA: AMCODA Press, 1999).

[8] See Tangredi, pp. 134-35 and McKenzie, pp. 4-5, pp. 40ff., and pp. 80ff. It should be noted, however, that access denial strategies must be fairly comprehensive to be effective. U.S. capabilities to conduct "standoff" warfare with Air Force theater assets (not including long range bombers or carrier-based aviation) from outside the range of most NBC/M weapons remains considerable, especially for a region such as Southwest Asia. Brian Chow of RAND notes: "The US standoff option in Southwest Asia is inherently robust to the loss of an ally or two. Even if Saudi Arabia and the other Gulf Cooperation Council countries do not allow US offensive combat sorties, there are still enough bases in Turkey, Israel, Kuwait, and outlying states to provide essentially the same sortie-generation capability for six tactical fighter wings…. Only if all Muslim countries deny the US basing rights does the sortie generation rate fall off appreciably." If the U.S. also could not fly out of Israel, U.S. standoff capability would be extremely challenged. Brian G. Chow, et al., "Air Force Operations in a Chemical and Biological Environment" (Santa Monica, CA: RAND, 1998), pp. 62-3. On the vulnerability of

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deployed air forces to chemical and biological attack see Byron C. Hepburn, "Chemical-Biological Attack: Achilles Heel of the Air Expeditionary Force?" Future Warfare Series, Counterproliferation Paper No. 4 (Sep. 1999), Maxwell AFB, AL: Air War College, 1999.

[9] Elaine M. Grossman, "Air Force QDR Chief Unveils Concept to Counter Access Denial Threat," *Inside the Pentagon*, vol. 16, no. 39 (September 28, 2000), p.1. For one of the original expositions of the Global Reconnaissance concept, see Robert W. Chandler, with John R. Backshies, *The New Face of War: Weapons of Mass Destruction and the Revitalization of America's Transoceanic Military Strategy* (McLean, VA: AMCODA Press, 1998).

[10] U.S. General Accounting Office, *Weapons of Mass Destruction: DOD's Actions to Combat Weapons Use Should Be More Integrated and Focused*, GAO/NSIAD-00-97, (Washington, D.C.: GAO, May 2000), p. 18ff.

[11] "Interview: Maj Gen Tom Neary." *Jane's Defense Weekly*, vol. 29, no. 1 (Jan. 7, 1998), p. 32.

[12] While making this assertion, one must be careful to note the critical role that Special Operations Forces (SOF) must play. U.S. Special Operations Command (USSOCOM) identifies "counterproliferation of weapons of mass destruction" as its "highest operational priority" and invests heavily in improving SOF capabilities to perform counterproliferation missions. However, relying upon the limited available evidence, it appears that, in general, the SOF contribution is likely to be in the areas of intelligence, reconnaissance, and surveillance/tagging. SOF faces many of the same operational and technical challenges that conventional forces face in dealing with NBC/M. For example, while in theory the use of SOF to eliminate NBC weapon stockpiles with minimal collateral effects is a good idea, in practice the options for SOF would appear to be: destroy, neutralize, render unusable, or deny access (by securing, obstructing, or removing). Moreover, SOF can only exercise these options after gaining access and locating the materials, perhaps in the tunnels of a deep underground facility or in a highly secure facility located in an urban area. SOF role in mobile missile defeat is likely to be more promising. See: U.S Special Operations Command, "Posture Statement 2000: Providing Unique Solutions for A Changing World," on-line, internet, December 13, 2000, available from http://www.defenselink.mil/pubs/sof/index.html and Glenn W. Goodman, Jr., "Deep Underground Tunnels: Counterproliferation Mission Takes SOF Commandos Into Tough New Environments," *Armed Forces Journal International*, vol. 134, no. 11 (June 1997), p. 61.

[13] U.S. Department of the Air Force, Headquarters U.S Air Force, Air Force Quadrennial Defense Review, "Global Reconnaissance-Strike: A Strategic Underpinning for QDR/Vision Force and JV2020," Draft Briefing, November 13, 2000. See also, David A. Fulghum, "USAF Plans Rapid, All-Stealth Task Force," *Aviation Week and Space Technology*, on-line, internet, February 26, 2001, available from http://ebird.dtic.mil/Feb2001/e20010226usafplans.htm.

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[14] Robert Wall, "USAF Updates Plans for Future Air Wars," *Aviation Week and Space Technology*, January 29, 2001, p 61, on-line, internet, February 7, 2001, available from http://ebird.dtic.mil/Feb2001/s20010206usaf.htm.

[15] On Gulf War NBC/M operations, see Thomas A. Keaney and Eliot A. Cohen. *Revolution in Warfare? Air Power in the Persian Gulf* (Annapolis, MD: Naval Institute Press, 1995), pp. 66-78; Robert W. Chandler, *Tomorrow's War*, *Today's Decisions: Iraqi Weapons of Mass Destruction and the Implications of WMD-Armed Adversaries for Future U.S. Military Strategy* (McLean, VA: AMCODA Press, 1996); and William M. Arkin, "Week Eight: Don't Know Much About Biology," *Stars and Stripes Omnimedia*, Sept. 18, 2000, on-line, internet, available from http://www.stripes.com/servlet/News/ViewArticle?articleId=100000508.

[16] While important differences do exist among nuclear (and radiological), biological, and chemical weapons, the various chemical and biological agents, and their delivery means, this paper will not discuss those differences. Nor will it discuss the potential lethality or destructiveness of these weapons. It should be noted, in passing, that the potential lethality and destructiveness of NBC weapons and their effects on the ability of U.S. forces to conduct military operations remains a topic of lively debate within the Department of Defense.

Chapter 2

NBC/M Counterforce Operations

I would say that the so-called 'asymmetrical' threats constitute more significant threats today that the risks of a major land, sea or air war, where some country decides to threaten Western armies and navies and air forces.

—U.S. Secretary of Defense Donald Rumsfeld, March 9, 2001

For many readers, within the context of NBC/M operations, the term “counterforce” immediately evokes one of two images. One is a preemptive military strike, undertaken with the objective of unilaterally and decisively disarming an adversary’s nascent or fielded NBC capabilities. The 1981 Israeli raid against the Iraqi Osirak nuclear reactor springs to mind as the prototypical operation in this regard. The other is mobile missile search and destroy missions, or “Scud hunting” as these operations became known in Operation DESERT STORM, which would be undertaken as adjunct to theater missile active defense. These images, however, reflect but narrow aspects of the type of operations the U.S. military would likely to be called upon to perform in dealing with NBC/M and protecting U.S. interests. This chapter will explore the broader range of abstract roles and contributions that NBC/M counterforce could make, highlighting the strengths and inadequacies of our current NBC/M counterforce approach. It endeavors to promote an improved understanding of the potential ways NBC/M counterforce operations could contribute to counterproliferation and military objectives.

NBC/M Counterforce: Moving Towards a Definition

NBC/M counterforce is not a "mission" of the armed forces, assigned to a specific military service or command that must prepare for and execute activities relating to that mission. Most concisely, NBC/M counterforce could be described as a term for characterizing the types of military actions taken against: NBC weapons, NBC delivery means, and theater conventional ballistic and cruise missiles; their capabilities; and their operational and supporting logistical infrastructure.[1] DoD identifies (NBC/M) counterforce as one of seven "functional areas" for programming and acquisition purposes under the DoD Counterproliferation Initiative (proliferation prevention, strategic and tactical intelligence, battle-field surveillance, passive defense, active defense, counterforce; and countering paramilitary, covert delivery, and terrorist NBC threats).[2]

In fact, current U.S. military Joint Staff publications do not provide an official definition of counterforce within a NBC or NBC/M context, nor does Joint Doctrine address NBC/M as a separate topic for its doctrine series. The single definition for "counterforce" in the Department of Defense/Joint Chiefs of Staff dictionary (Joint Publication 1-02) is of cold war vintage: "The employment of strategic air and missile forces in an effort to destroy, or render impotent, selected military capabilities of an enemy force under any of the circumstances by which hostilities may be initiated."[3] Discussions of NBC/M counterforce issues can be found in Joint Publications 3-01.5, *Doctrine for Joint Theater Missile Defense* and in Joint Publication 3-11, *Joint Doctrine* *for Operations in Nuclear, Biological, and Chemical (NBC) Environments* (and to a lesser extent in Joint Publication 3-01, *Joint Doctrine for Countering Air and Missile Threats*).[4]

As the JCS-designated lead service for NBC/M counterforce, the U.S. Air Force has acted to help fill this doctrinal void. Air Force Doctrine Document (AFDD) 2-1.8, *Counter Nuclear, Biological, and Chemical Operations* –published in August 2000—provides a concise treatment of NBC/M counterforce operations, along with the other components ("pillars") of counter NBC Operations—proliferation prevention, active defense, and passive defense. AFDD 2-1.8 also offers a useful definition of NBC (NBC/M) counterforce operations as currently conceived, but one which may restrict the understanding of potential counterforce contributions: "Operations that are intended to divert, deny, degrade, or destroy an adversary's NBC capability and its supporting infrastructure before it can be used against friendly forces."[5]

NBC/M Counterforce: Expanding the Concept

AFDD 2-1.8 notes, this is an "effects-based" definition—it focuses on the effects that the commander would desire to achieve versus the means he might employ. As such, it advances the discussion of NBC/M counterforce, in two significant—yet perhaps not readily apparent—respects. First, it recognizes that NBC/M counterforce operations below the level of a comprehensive disarming strike can make essential contributions to counterproliferation and warfighting objectives and will do so without having "destruction" as a singular measure of success. In practical terms, this means a comprehensive counterforce approach should embrace plans, requirements, and programs that reflect capabilities for achieving a variety of effects other than complete destruction (*e.g.*, suppression, denial, degradation). Second, the AFDD 2-1.8 definition and discussion suggests to planners a holistic, better-integrated approach to NBC/M counterforce operations and the development of NBC/M counterforce capabilities.[6] The definition attempts to bring together all of the offensive military operations and planning activities that would be undertaken to counter an adversary's NBC and missile capabilities under a single umbrella concept—a concept that this paper suggests, warrants recognition as a unique mission area and dedicated funding resources.

Today, no unified approach to NBC/M counterforce currently exists. Two separate, excessively circumscribed approaches coexist: NBC/M facility defeat—the approach to the infrastructure/fixed target aspect; and Time Critical Targeting (TCT)—the approach to the mobile missile aspect. The NBC/M facility defeat approach has emphasized enhancing existing precision attack capabilities to deal with the (relatively small) NBC/M facilities target set. Much of the progress the NBC/M facility defeat approach has made could be attributed to the fact that these enhanced capabilities promised to yield benefits for fixed (hardened) target sets beyond NBC/M facilities *(e.g.*, command and control, military production). This approach has recognized that immediate solutions were necessary for critical operational challenges.

The Time Critical Targeting approach has been synonymous with "attack operations"—offensive operations that are conducted against mobile missiles to supplement active and passive NBC/M defense.[7] Moreover, attack operations has been overly focused on missile transporter erector launcher (TEL) destruction following missile launch.[8] The Time Critical Targeting approach has emphasized conceptual innovation and experimentation—nonmaterial process improvements requiring little commitment of resources unless implemented. The approach has focused more on the long-term, devoid of any sense of urgency. As a result, the careful and competent study of mobile missile targeting that has taken place has not readily translated into fielded capabilities.

The AFDD 2-1.8 definition also, however, constrains the discussion and understanding of NBC/M counterforce, and does so by the inclusion of the phrase "*before* it [NBC capability] can be used against friendly forces"(emphasis added). This is unfortunate for two reasons. First, it maintains the politically sensitive issue of the pre-hostilities use of NBC/M counterforce operations—commonly referred to as "preemption"—as a focus of NBC/M counterforce discussions. Preemption options represent but a small (and arguably minor) subset of potential NBC/M counterforce operations, and since (essentially) the same capabilities are required to conduct NBC/M operations—in pre-crisis, crisis, or the combat phases of a conflict (although, perhaps, in different quantities)—the *first* question rightly should be "What capabilities are required to locate and neutralize, degrade, or destroy NBC/M capabilities in order to achieve the effects that the theater commander would seek to achieve?" Questions relating to preemption that have dominated the counterforce discussion—whether the U.S. should contemplate preemptive strikes against proliferators, how preemptive strikes could be conducted, and how effective preemptive strikes might be—should be secondary.[9]

Second, the phrase "before it can be used against friendly *forces*" (emphasis added) in the Air Force definition, might lead us to narrow our view of scenarios in which NBC/M counterforce operations could play a significant role. The secondary/tertiary role of NBC/M operations play as a part of large-scale, combined arms operations is only one role, and one that usually relegates NBC/M counterforce effects to the status of a secondary objective. Yet, even this role requires reevaluation in light of specific enhancements in counter NBC/M capabilities (see Chapter 4) and the significant improvements in surveillance and sortie effectiveness achieved since DESERT STORM.[10] With perhaps one exception, no new analysis has emerged since 1993 to provide a rough-order-of magnitude assessment of the operational requirements of NBC/M counterforce campaign against a well-defended proliferator and of the campaign's impact on broader theater objectives.[11]

The discussion in Chapter 1 highlighted one potential scenario that is expanding our view of the role of NBC/M counterforce operations—countering NBC/M that an adversary might employ as part of an anti-access strategy.[12] Moving beyond the anti-access scenario, other scenarios are also possible in which NBC counterforce operations could be conducted independent of ground force employment or other military operations—for example, before adversaries could use NBC/M against friendly *civilians.* Such a scenario could occur by default, should the active defense capabilities that are under *development*—and upon which U.S. military planning so heavily depends: not be fielded timely (see Chapter 4), or in sufficient numbers to meet the size/sophistication of threat or the geographic dispersal of potential targets. In some cases the emphasis on NBC/M counterforce operations may only be temporary, if additional active defense assets, with time, could be made available and could provide effective protection for population centers. This temporary period might be as short as three days or four days, the time it would likely take to deploy ground-based or sea-based active defense assets to an area.[13] Or, counterforce operations may be the only response. As a recent U.S. Army war game revealed, the likely further proliferation of NBC/M capabilities in the Middle East challenges the ability of active defense assets to provide wide protection to all of the places an adversary might threaten.[14]

Another potential scenario is the destruction of specific NBC/M capabilities through counterforce operations by design. As suggested by the U.S. August 1998 cruise missile strike against the suspected chemical weapon precursor facility in Khartoum, NBC/M counterforce operations could be used to conduct punitive strikes.[15] Effective punitive strikes require the targeting of an asset that an adversary highly values. NBC/M capabilities potentially represent such high value assets; proliferators commit tremendous amounts of human and financial capital to developing and protecting their NBC/M assets (see Chapter 3), and some of these assets—specifically the warheads and delivery vehicles—are not easily or quickly replaced.[16]

The punitive retaliation scenario particularly challenges our current conception of NBC/M counterforce. First, in this scenario NBC/M counterforce is used at a time when there is no imminent or ongoing military conflict. Second, military operations are directed against NBC/M capabilities that were not involved in the adversary's action (behavior) that precipitated the punitive response and do not, necessarily, directly contribute to the adversary's capability to conduct that action (engage in that same behavior) in the future.[17]

The challenges of this scenario, as well as those presented by other potential scenarios, suggest that the U.S. military should embrace a more expansive view of the range of NBC/M counterforce operations that it may be called upon to perform. As the following chapters emphasize, it is imperative that we give more detailed thought to the

NBC/M counterforce employment concepts and a greater priority to the NBC/M counterforce capabilities such scenarios would require.

Notes

[1] This paper will not discuss the offensive military operations against aircraft that could be used for NBC delivery, which likely would be dealt with as part of offensive counterair operations. Arguably, existing (and programmed) U.S. capabilities are more than adequate to deal with this threat. The author accepts the criticism in advance that this paper's focus on the conventional means of NBC agent delivery, neglects the various alternative means of delivery that will likely pose tremendous detection and population/force protection challenges. As a first step, this paper deals with existing and demonstrated capabilities. For an assessment of the NBC threat including non-conventional means of delivery, see John Mueller and Karl Mueller, "The Methodology of Mass Destruction: Assessing Threats in the New World Order," *The Journal of Strategic Studies*, vol. 23, no. 1 (March 2000), pp. 163-187. This paper does include conventional ballistic missiles in the same category as NBC weapons, and for the following reasons: modern ballistic missiles have proven themselves to be an effective tool for intimidating governments and causing civilian panic, as demonstrated in the Iran-Iraq War and during DESERT STORM. As expressed by Robert Walpole, the Central Intelligence Agency's National Intelligence Officer for Strategic and Nuclear Programs, proliferators view theater (ballistic) missiles in a similar manner as NBC weapons, "more as strategic tools of deterrence, coercive diplomacy, and not as operational weapons of war." Moreover: 1) given the difficulty of weaponizing and effectively delivering NBC agents with a ballistic missile, conventional warheads could produce equivalent casualties and more dependable (anticipated) results; 2) ballistic missiles convey prestige and look much more impressive in a military parade than an aerosol sprayer or many cheap small, remotely piloted vehicles (RPVs); and 3) defenders do not know with certainty what type of warhead is on a ballistic missile until after warhead detonation. U.S. Cong., Senate, Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, "Statement for the Record to the International Security, Proliferation, and Federal Services Subcommittee of the Senate Government Affairs Committee by Robert D. Walpole, National Intelligence Officer for Strategic and Nuclear Programs," September 21, 2000.

[2] On the Defense Department's Counterproliferation Initiative, see Barry R. Schneider, *Future War and Counterproliferation: U.S. Military Responses to NBC Proliferation Threats* (Westport, CN: Praeger, 1999), pp. 45-62; Henry D. Sokolski, "Mission Impossible," *Bulletin of Atomic Scientists*, March/April 2001, p. 62, on-line, internet, March 16, 2001, available from https://ca.dtic.mil/cgi-bin/ebird?doc_url=/ Mar2001/s20010316mission.htm; and the Reports of the Counterproliferation Program Review Committee (U.S. Department of Defense, Counterproliferation Program Review Committee, *Report on Activities and Programs for Countering Proliferation and NBC Terrorism. Executive Summary*, April 2000 (Washington, D.C: GPO, 2000); hereafter, CPRC Report *Executive Summary*). Reports currently are available for 1994-2000.

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[3] JP1-02, p. 112.

[4] This omission is puzzling considering Joint Doctrine's separate treatment of topics such as electronic warfare and information operations. In light of the conclusions of defense policy studies cited earlier, in the future one would expect NBC/M counterforce operations to receive at least equivalent treatment as such less 21st Century relevant operations as landing force operations and amphibious embarkation. See U.S. Department of Defense, Joint Chiefs of Staff, *Doctrine for Joint Theater Missile Defense*, Joint Pub 3-01.5, 22 February 1996 (Washington, D.C.: GPO, 1996) and Joint Pub 3-11.

[5] U.S. Department of the Air Force, U.S. Air Force Doctrine Center, *Counter Nuclear*, *Chemical*, *and Biological Operations*, Air Force Doctrine Document 2-1.8 (Maxwell AFB, AL: Air Force Doctrine Center, Aug. 16, 2000), p. 8.

[6] Some indications that this approach is taking hold are the planning tools being developed for facility targeting and for time critical targeting. See the discussion of these topics in Chapter 5.

[7] "Attack operations" is the term that Joint organizations use to refer to these operations. The Air Force prefers the term "immediate offensive counterair operations."

[8] There are, however, encouraging signs that this post-launch focus is changing. Operational concepts under development by Joint Theater Air and Missile Defense Office (JTAMDO) Joint Attack Operations Working Group and the Joint Warfighting Capability Assessment (JWCA) process (and being explored in exercises by U.S. Forces Korea) are expanding this focus to embrace a broader range of mobile missile operations.

[9] See, for example, the discussion of preemption in Sokolski, "Mission Impossible."

[10] Since 1991, the U.S. military has achieved tremendous advances in sortie efficiency through the use of precision-guided munitions (PGMs—weapons that use a seeker to guide the weapon) and Global Positioning System (GPS) guided weapons. For the Air Force, the recent the combination of the heavy weapon loads of the B-2 bomber and the GPS guided Joint Direct Attack Munition (JDAM) have further increased this efficiency (the B-2 currently carries sixteen 2000lb JDAMS but will be carrying up to eighty 500lb JDAMs or one hundred and twenty-eight 250lb JDAMs by 2006-07). Moreover, in contrast to 1991, almost the entire fleet of Air Force fighter aircraft is now capable of delivering PGMs. Other munitions developments have contributed to higher sortie efficiencies for area denial as well (the Wind Corrected Munition Dispenser and the Sensor Fused Weapon). These efficiencies translate to sorties that are freed up for additional tasking. On PGM and latest JDAM developments see Air Force, "Global Reconnaissance Strike;" Chandler, *New Face of War;* and France, Linda de, "Miniaturization, Seeker Improvements, Set Munitions Roadmap," *Aerospace Daily* March 27, 2001, on-line, internet, March 27, 2001, available from http://ebird.dtic.mil/Mar2001/s20010327mini.htm.

Naval Aviation capabilities have also dramatically increased. The primary mission of the carrier air wing has shifted from maritime superiority to power projection from the sea and the air wing has increased both its stocks of PGMs (doubled from 200 to 400 weapons) and number of PGM capable aircraft (all strike assets are now PGM capable). In exercises, the carrier air wing has also demonstrated the ability to "surge" the number

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of strike sorties it can generate from 125 to 200 sorties a day for limited periods of time (up to 4 days with personnel augmentation). See U.S. Department of the Navy, Chief Information Officer, "Intensive Aircraft Carrier Firepower Demonstrated," NNS3401, March 4, 1997, on-line, internet, October 10, 2000, available from http://www.chinfo.navy.mil/navpalib/news/navnews/nns97/nns97034.txt.

[11] To some extent Chandler's *New Face of War* updates Philip Zelikow's earlier examination of the operational requirements of an NBC/M counterforce campaign against an Iraqi-sized proliferator. See Philip Zelikow, "Offensive Military Operations," in *New Nuclear Nations: Consequences for U.S. Policy*, eds. Robert D. Blackwill and Albert Carnesale (New York: Council on Foreign Relations Press, 1993), pp. 162-195. See also an earlier piece by Robert W. Chandler, "Counterforce: Locating and Destroying Weapons of Mass Destruction," Occasional Paper No. 21 (U.S Air Force Academy, CO: Institute of National Security Studies, September 1998), on-line, internet, Sept. 13, 2000, available from http://www.usafa.af.mil/inss/ocp21.htm.

[12] However, even in the operational concept behind this scenario there is little evidence of detailed thought about how NBC/M counterforce might be conducted and for what specific objectives. The most recent Air Force anti-access concept—"Global Strike Task Force"—envisions using the stealthy precision strike assets (F-22 and B-2 equipped with Joint Direct Attack Munitions (JDAMs) and Small Smart Glide Bombs) to "destroy the most critical targets in 1-3 days of long-distance strikes." Discussions of the concept, however, do not seem to indicate that planners include NBC/M fixed capabilities on the critical targets list, nor are the specific weapons that Global Strike Task Force emphasizes (JDAM and small smart bombs) particularly effective against the hardened or mobile targets that are likely to comprise the NBC/M target set. See General John P. Jumper, "Global Strike Task Force: A Transforming Concept, Forged by Experience," *Aerospace Power Journal*, vol. XV, no. 1 (Spring 2001), pp. 24-33. See also, Frank Wolfe, "Jumper Lays Out Future CONOPS For Global Strike Task Force," *Defense Daily*, February 20, 2001, p. 5, on-line, internet, February 20, 2001, available from http://ebird.dtic.mil/Feb2001/s20010220jumper.htm. See Chapter 5 discussion and notes on weapons and munitions as well.

[13] Based on DESERT STORM experience, it could take three days to get Patriot assets to an area and operational (the Patriot deployment to Israel, alone, required 48 hours to complete). Depending on the nature and location of Navy deployments, it could take up to four days for the sea-based assets to reach an area. Counterforce operations using self-deploying theater air assets or long-range aerospace forces could prove more responsive (ships travel at 20 knots, aircraft travel at 400 knots).

[14] Jeff Bennett, "SMDC War Game Reveals Theater Missile Defense Shortfalls," *Inside Missile Defense*, March 21, 2001, p. 1, on-line, internet, March 21, 2001, available from http://ebird.dtic.mil/Mar2001/s20010321smdc.htm.

[15] As part of Operation INFINITE REACH on August 20, 1998, the U.S. launched approximately 70 Tomahawk Land Attack Missiles (TLAMs) against targets in Khartoum (El Shifa) and Khost, Afghanistan, in response to bombings on August 7 of the U.S. Embassies in Nairobi, Kenya, and Dar es Salaam, Tanzania. The goals of these

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strikes were "to disrupt [Osama] bin Ladin's terrorist network and destroy elements of its infrastructure in Afghanistan and Sudan. And our goal was to destroy in Sudan the factory with which bin Ladin's network is associated, which was producing an ingredient essential for nerve gas" (President Clinton, Radio Address to the Nation, August 22).

[16] NBC/M counterforce strikes might also be used more extensively as a coercive strategy based on what Karl Mueller refers to as "countervalue military targeting." See Karl Mueller, "Countermilitary Strategies for Coercion: Threatening What the Enemy Values," Paper prepared for presentation at the International Studies Association 42nd Annual Convention, Chicago, Ill., February 21-24.

[17] See Mueller, "Countermilitary Strategies for Coercion."

Chapter 3

The NBC/M Middle East Regional Threat

> *The United States must develop capabilities that will allow it to defend against and respond to the use of NBC weapons on its own terms, rather than on those dictated by an autocratic or theocratic proliferant state. Threats to use NBC weapons must not become useful instruments of the weak to blackmail or coerce the strong.*
>
> — U.S. Deputy Assistant Secretary of Defense
> For Counterproliferation Policy
> Mitchel B. Wallerstein, 1998

Although the strategic context for counterforce operations must embrace NBC/M programs in all regions of the globe, the prominence of the Middle East as a region of concern in the near- to mid-term is unmistakable. In the recently published Defense Department report on NBC proliferation (*Proliferation: Threat and Response*),[1] three of the four countries cited as of greatest proliferation concern are located in the Middle East: Iran, Iraq, and Libya. Five of the ten NBC proliferators that warranted inclusion in the report can be found in the Middle East: Iran, Iraq, Syria, Libya, and Sudan; and the Middle East section of the report is by far the largest section of the report. Moreover, the most significant of the transnational threats discussed in the report—the terrorist organization of Osama bin-Laden—is essentially a Middle East issue. In brief, in no other region of the world today do we see such an ominous combination of NBC/M capability, impulse to confront the U.S. (and intimidate neighbors with military force), and demonstrated willingness to employ NBC/M weapons (see Tables 1 & 2, below).

Syria and Libya

Considering the current volatility of the entire Middle East region and its history full of "crises that suddenly turned into unintended conflicts and escalations in the use of force," even the relatively more modest NBC/M programs belonging to Libya and Syria warrant attention.[2] Libya—the country "with the 'dubious distinction' of being the only country in the region to have fired a long range missile on a Western target," having fired a Scud missile at the Italian Island of Lampadusa following the U.S. ELDORADO CANYON strikes in 1986—remains committed to improving its offensive NBC/M capability.[3] It has, however, made little progress towards this goal. Its chemical production at Rabta and at the deep underground facility at Tarhunah appear inactive and its aging Scud missile force is now of "questionable" operational status.[4] Nonetheless, Libya continues to seek improvements in its delivery means and wants to acquire or indigenously produce North Korea's Nodong-1 missile. Tripoli also continues to research and develop a biological weapon capability. Rapid developments in either the missile or biological warfare programs in Libya are not expected.[5]

Syria, which believes that its chemical and missile forces act as a deterrent against Israeli attack, has weaponized chemical agents and maintains a missile force of several hundred Scud-B, Scud-C, and SS-21 mobile missiles. The range of these missiles is sufficient to reach targets in Jordan, Iraq, and Turkey as well. With North Korean assistance, Syria is producing its own Scud-Cs and is working towards the development of a solid-propellant short-range ballistic missile. *Proliferation: Threat and Response* also notes that Syria is developing a biological weapons capability.[6] Syria stores its mobile launchers and missiles in tunnels[7] and is suspected of sheltering its chemical weapons in a deep underground facility (rail tunnel). Commercial tunneling projects for water conveyance into the Lebanon Mountains (200m maximum overburden), demonstrate both the geological features and capability for the construction of such facilities.[8]

Iran

Iran concluded long ago that NC/M capabilities were essential for its national security and the country has devoted considerable resources to not only acquiring them, but to becoming self-sufficient in their production as well. It has manufactured and stockpiled several hundred tons of chemical weapons, holds "some stocks of BW [biological warfare] agents and weapons,"[9] and posses a force of hundreds of Scud-B, Scud-D, and Chinese CSS-8 short range ballistic missiles. It has built, tested, and displayed an indigenously produced medium range ballistic missile (Shahab-3, a North Korean Nodong-1 variant) and acknowledged developing yet another more capable medium range ballistic missile (Shahab-4). It has also constructed a series of tunnels along its southwest coast as forward deployment facilities for its missiles and missile related equipment in wartime.[10] Iran is continuing work on its nuclear reactor at Bushehr, with technical support from a number of countries.[11]

With cooperation from abroad, particularly from Russia, the Islamic Republic moves ever closer to its goal of NBC/M production self-sufficiency. Russia recently terminated its agreement with the U.S.—the Gore-Chernomyrdin Agreement—in which it pledged not to conclude any new arms agreements with Iran, and with increased revenues from high oil prices, Iran is an attractive partner.[12] Meanwhile, Russian export control enforcement has become selective, at best, making it easier to Iran to obtain the dual use technologies the country has sought for its chemical and biological weapons programs.[13] The Russian Defense Minister's visit to Iran in December (a first since the Islamic Revolution in 1979) has further underscored this cooperation. The most recent Intelligence Community testimony highlights the importance of the Russian connection: "the transfer of ballistic missile technology from Russia to Iran was substantial last year, and in our judgment will continue to accelerate Iranian efforts to develop new missiles and to become self-sufficient in production."[14]

Equally alarming, is the evidence of the central role NBC/M capabilities would play in a conflict with the United States. Since the Gulf War, most major Iranian military exercises have incorporated Iranian nuclear, chemical, and biological operations. The frequency of Iranian chemical exercises has increased "dramatically," and two-thirds (14) of those chemical exercises have been held in the Persian Gulf.[15] These exercises are especially alarming, for the Iranians appear to subscribe to the belief that "the tactical use of chemical and biological weapons at sea generally is underrated in Western military circles."[16] Moreover, since Iranian vessels "would have the greatest chance of closing on U.S. naval forces" prior to the actual onset of hostilities, Iranian chemical and biological use could occur early rather than later in a conflict.[17]

Iraq

Not a week goes by that the press does not report a new development in Iraqi NBC/M programs. Most recently, the British press reported the release of a German Federal Intelligence Agency (BND) report on Iraq indicating that Saddam Hussein was modifying his short-range Al Samoud missiles (capable of hitting Israel) with a precision guidance capability. More disturbing, is the rebuilding of an Iraqi chemical and biological weapons production capability: "The number of known chemical production projects in Iraq has risen to 80 with almost a quarter of them specifically working on weapons production."[18]

Definitive statements on Iraqi capabilities are impossible in the absence of further inspections, but evidence indicates a commitment to NBC/M rearmament. In addition to its ballistic missiles, Iraq has continued its development of an unmanned aerial vehicle (UAV; a modified L-29 jet trainer aircraft) for delivery of chemical, or more likely, biological warfare agents. It is suspected that Iraq has hidden chemical munitions and "retains a small, covert force of Scud-type missiles" (Scud-B, Al-Hussein).[19] With its infrastructure and knowledge base, Iraq could "produce quickly a large amount or BW agents at any time, if needed."[20]

Similar to Iran, it is clear that the NBC/M capabilities Saddam Hussein retains and develops, he plans to use. Past Iraqi chemical and missile operations reveal detailed planning for use of NBC/M. Prior to the Gulf War, the Iraqis constructed fixed missile sites in the western dessert, to acquire a capability for strategic retaliation against Israel through chemical and biological strikes against Israeli cities. When these sites could not be completed prior to the anticipated commencement of Coalition operations in the Gulf War, the Iraqis cannibalized the launchers to construct mobile launchers.[21]

Iraqi operations during the Gulf War indicated that considerable thought had been given to the movement and safeguarding of NBC warheads, the command and control of NBC/M weapons, and the preservation of a NBC/M strategic reserve. The fact that chemical munitions were forwarded deployed to secure sites in southeastern Iraq during DESERT STORM indicates that plans for their use did exist and that chemical operations are thoroughly integrated into concepts of operations. Chemical warheads were stored separately from delivery systems, and Saddam Hussein mostly likely retained release authority of their use. The Iraqis also apparently deployed seven missiles to the western desert "to execute unconventional [NBC] missions" or, less likely, as a "conventional strategic reserve."[22] Such extensive planning and operational experience indicates that Saddam Hussein would have a high degree of confidence in the ability of Iraqi force's to conduct NBC/M operations in the future and that the U.S. should expect to encounter NBC/M operations should a conflict arise.

Regional Assessment

While America debates the timing and severity of the future threat to the continental United States from NBC/M weapons, an existing threat posed by nuclear, biological, and chemical weapons and high performance theater and intermediate range missiles in the Middle East intensifies. This threat menaces not only our allies and the 20-25,000 troops the U.S. has deployed in the region on any given day, but the very ability of the U.S. to conduct expeditionary operations in the region in defense of its interests and allies. Regrettably, the NBC/M threat is one that the U.S. military has failed to address adequately in the last ten years, a subject to which the discussion will now turn.

Table 1. Select NBC/M Programs in the Middle East [23]

	Nuclear	Biological	Chemical	Delivery	Potential Future Delivery
Iran	Development/ Pursuing Weaponization	Production	Weaponized/ Employed	TBM AC/ART/RKT	L/S/A-ASCM
Iraq	Development/ Pursuing Weaponization	Weaponized	Weaponized/ Employed	TBM AC/HEL/UAV ART/RKT	L-ASCM
Libya	Initial Development	Development	Weaponized/ Employed	AC/ART/RKT	L/S-ASCM
Syria	No	Development	Weaponized	TBM AC/HEL ART/RKT	L/S-ASCM

TBM-theater ballistic missile
AC-aircraft
ART-artillery
RKT-rocket
UAV-unmanned aerial vehicle
L/S/A-land, ship, air launched
ASCM-anti-shipping cruise missile
HEL-HELICOPTER

Table 2. Middle East Region: Select Theater Ballistic Missile Capabilities[24]

Country	Missile Type	Launchers	Missiles	Range (km)
Libya	Scud-B	80	500	300
	Al-Fatah	*(under*	*development)*	1000
	Nodong-1	*(seeking to*	*purchase)*	1300
Syria	SS-21		36	75-100
	Scud-B	18-26	200	300
	Scud-C		100	500
	Scud-D	*(tested;*	*depl. pending)*	700
Iran	CSS-8	16	200	150
	Shahab-1 (Scud-B)	10-20	300	300
	Shahab-2 (Scud-C)	(same as Scud B)	100	500
	Shahab-3 (Nodong-1)	*(1-3 prototyped;*	*potentially 12)*	1300
	Shahab-4	*(under*	*development)*	2000
Iraq	Al-Samoud (permitted)	*(under*	*development)*	100-150
	Al-Hussein (prohibited)	+	6-16	650

Notes

[1] *Proliferation: Threat and Response*, January 2001.

[2] A dated but useful background work on NBC weapons in the Middle East is Anthony H. Cordesman, *Weapons of Mass Destruction in the Middle East* (McLean, VA: Brassey's, 1991); see Cordesman, p. 166.

[3] Anthony H. Cordesman, *Transnational Threats from the Middle East: Crying Wolf or Crying Havoc?* (Carlisle, PA: U.S. Army War College Strategic Studies Institute, 1999), p. 96.

[4] *Proliferation: Threat and Response*, pp. 47.

[5] U.S. Director of Central Intelligence, "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 2000." on-line, internet, March 9, 2001, available from http://www.fas.org/irp/threat/bian_feb_2001.htm (hereafter, DCI "Report on Acquisition").

[6] *Proliferation: Threat and Response*, pp. 42-45; see also, DCI "Report on Acquisition."

[7] Angelo M. Codevilla, "Missile, Defense and Israel," IASPS Research Papers in Strategy, No. 5 (Washington, D.C.: Institute for Advanced Strategic and Political Studies, November 1997), p. 9.

[8] Information on tunneling projects and the availability of tunneling equipment can be found at www.tunnelbuilder.com and through links to tunneling equipment companies (*e.g.*, Robbins) websites. Information on tunneling used in this paper was obtained from tunnelbuilder on December 21, 2000.

[9] U.S. Cong., Senate, Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, "Statement by Deputy Director, DCI Nonproliferation Center, A. Norman Shindler, on Iran's Weapons of Mass Destruction Programs to the International Security, Proliferation, and Federal Services Subcommittee of the Senate Government Affairs Committee," September 21, 2000.

[10] Barbara Starr, "USA Plans to Dig Deep in Search of Iraqi Weapons," *Jane's Defense Weekly*, vol. 29, no. 3 (January 21, 1998.), p. 4.

[11] For more recent developments in the Iranian NBC/M program see *Proliferation: Threat and Response*, pp. 34-38 and DCI "Report on Acquisition." For background on the Iranian program, see Michael Eisenstadt, "Living with a Nuclear Iran?" *Survival*, vol. 41, no. 3 (Autumn 1999), pp.124-48; Michael Eisenstadt, "Can the United States Influence the WMD Policies of Iraq and Iran?" *The Nonproliferation Review* (Summer 2000), pp. 63-76; U.S. Cong., Senate, Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, "Dealing with Iranian Missile and WMD Proliferation. Testimony of Michael Eisenstadt before Subcommittee on International Security, Proliferation, and Federal Services of the Senate Governmental Affairs Committee," September 21, 2000; U.S. Cong., Senate, Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, "Iran: Strategic Challenge. Statement for the Record by Dr. Stephen A. Cambone, Director of Research, Institute for National Security Studies, National Defense University," September 21, 2000; and Paula A. DeSutter, *Denial and Jeopardy:*

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Deterring Iranian Use of NBC Weapons (Washington, D.C.: National Defense University Press, 1997).

[12] On developments in Russian-Iranian cooperation, see Brenda Shafer, "Khatami in Moscow Boosts Russian-Iranian Arms Cooperation," Policy Watch No. 522 (Washington, D.C.: The Washington Institute for Near East Policy, March 5, 2001). For a broader appraisal of Russian-Iranian relations and Russian Middle East Policy, see Eugene Rumer, *Dangerous Drift: Russia's Middle East Policy*, Policy Paper No. 54 (Washington, D.C.: The Washington Institute for Near East Policy, 2000).

[13] U.S. Cong., Senate, Committee on Foreign Relations, "Statement of John A. Lauder, Director of Central Intelligence's Nonproliferation Center to the Senate Committee on Foreign Relations on Russian Proliferation to Iran's Weapons of Mass Destruction and Missile Programs," October 5, 2000, on-line, internet, November 20, 2000, available from http://www.ransac.org/new-web-site/related/govt/testimony/ lauder-10.05.00.html 10/24/00.

[14] "Lauder Statement;" Rumer's assessment is equally pessimistic: "[Russia's] Middle East Policy is chaotic…. the combination of corporate greed, lack of bureaucratic restraint, and a relaxed Russian views of proliferation means that Moscow is unlikely to be a reliable partner in the fight against proliferation." See Rumer, p. x.

[15] Gregory F. Giles, "The Islamic Republic of Iran and Nuclear, Biological, and Chemical Weapons," in *Planning the Unthinkable: How New Powers Will Use Nuclear*, *Biological*, *and Chemical Weapons*, eds. Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz (Ithaca: Cornell Univ. Press, 2000), p. 93.

[16] Giles, p. 96.

[17] Giles, p. 97. In spite of this Iranian view, it should be noted that the U.S. Navy surface combatants that the Iranians are likely to encounter are generally provided with collective protection and could effectively perform their missions while buttoned-up.

[18] Roger Boyes, "Iraq Builds Chemical Weapons System 'Capable of Hitting European Cities,'" *London Times*, on-line, internet, February 26, 2001, available from http://ebird.dtic.mil/Feb2001/e20010226builds.htm.

[19] DCI "Report on Acquisition."

[20] DCI "Report on Acquisition."

[21] Timothy V. McCarthy and Jonathan B. Tucker, "Saddam's Toxic Arsenal: Chemical and Biological Weapons in the Gulf Wars," in *Planning the Unthinkable: How New Powers Will Use Nuclear*, *Biological*, *and Chemical Weapons*, eds. Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz (Ithaca: Cornell Univ. Press, 2000), pp. 65-67.

[22] McCarthy and Tucker, pp. 75-77.

[23] Based on information contained in *Proliferation: Threat and Response*, and DCI "Report on Acquisition."

[24] Multiples Sources including: *Proliferation Threat and Response*; DCI, "Report on Acquisition;" Eisenstadt, "Russian Arms;" and Dore Gold, "Going Ballistic: Proliferation and Missile Defense in the Middle East," *The Review*, vol. 25, no. 9 (September 2000), pp. 10-13; and Shlomo Brom and Yiftah Shapir, eds., *The Middle East Military Balance: 1999-2000,* (Cambridge, MA: MIT Press, 2000).

Chapter 4

The Shield: U.S. Theater Missile Defense Active Defense Systems

The preferred method of countering enemy theater missile operations is to attack and destroy or disrupt theater missiles prior to their launch.

—Joint Publication 3-01.5, Doctrine for Joint Theater Missile Defense

The Family of Systems

In order to protect deployed U.S. forces and allies from the NBC/M threat, the Department of Defense is developing an integrated theater missile defense (TMD) "Family of Systems". The Family of Systems consists of six TMD active defense systems, and their associated sensors and command, control, and communication systems. The six TMD active defense systems are: Patriot Advanced Capability 3 (PAC-3); Navy Area Ballistic Missile Defense; Navy Theater Wide Ballistic Missile Defense; Army Theater High Altitude Area Defense (THAAD); the Medium Extended Air Defense System (MEADS); and the Airborne Laser (ABL). It is important to highlight the word "developing" in the first sentence of this paragraph, for while the threat already exists—as the preceding discussion NBC/M capabilities in the Middle East emphasized—the Family of Systems does not. In fact, even without further slips in development and acquisition of these six systems, it will likely be close to a decade before the family of system is complete and fielded (see Table 3, below).[1]

The family of system approach does, however, provide for the incremental introduction of systems and capabilities as they become available. Today, the U.S. military possesses a rudimentary TMD capability in the Patriot Advanced Capability 2 Guidance Enhanced Missile (PAC-2/GEM) that is currently deployed.[2] This rudimentary capability will be supplemented shortly by the PAC-3 system that is on the threshold of its initial operational capability (IOC; see PAC-3 discussion below). One ally, Israel, also posses a TMD system—the Arrow II—the first system specifically designed for TMD ever to be fielded.[3]

Nonetheless, DoD has adopted the Family of Systems approach to TMD primarily to enhance the effectiveness of the missile shield through the layering of defenses. Layered defenses provide multiple opportunities to engage theater ballistic missiles (TBMs) throughout their flight. The Family of Systems approach recognizes the complexity and diversity of the missile threat and the fact that no single system alone is capable of providing adequate defense. Furthermore, the Family of System approach recognizes that even with a deployed combination of one or more of these "active" defense systems, passive defense (protection), and counterforce operations (attack operations) will still be required to provide effective protection.[4]

Members of the Family: Boost-phase Intercept

The most desirable capability provided by members of the Family of Systems—that of boost-phase intercept—will not be available until 2008. At that time the Airborne Laser (ABL) should reach an initial operational capability if its deployment is accelerated.[5] Boost-phase intercept is desirable for multiple reasons. Interception during the boost phase results in debris from the missile (including any biological or chemical agents that are not dissipated) likely falling in enemy territory instead of friendly territory.[6] Boost-phase intercept capability negates advantages the enemy might gain through terminal countermeasures and submunitions.[7] Boost-phase intercept attacks the missile when it is most visible and vulnerable—during its powered flight. The primary disadvantage of the planned boost-phase system—the Airborne Laser—is its range, reported in unclassified sources to be 350km or less. In addition to its primary role as a TMD system, the Airborne Laser will also have a capability to attack aircraft or UAVs operating at high altitudes or surface-to-air missiles.

Members of the Family: Upper-tier

Next in desirability are the upper-tier or high altitude intercept systems. The Family of Systems is developing two upper-tier systems: the Army THAAD and Navy Theater Wide (NTW).[8] Upper-tier systems are optimized for defense against longer-range TBMs but they can engage short and medium range TBMs as well. Upper-tier systems can also mitigate some of the effects of falling debris (to include biological and chemical agents) and terminal countermeasures. Specifically, upper-tier intercept may force an adversary to release submunitions earlier than would be desirable for optimal dispersal and maximum effectiveness.

An upper-tier capability is likely to be fielded much more timely than a boost-phase capability. THAAD is scheduled for first deployment in Fiscal Year 2007 (FY2007), in an initial configuration (Configuration I) that addresses the anticipated 2007 TBM threat.[9] A more robust version that includes the capability to deal with sophisticated countermeasures (Configuration II) will not be fielded until FY2011. Similarly, Navy Theater Wide will "pace the threat" and be introduced incrementally. The Navy expects to deploy a contingency capability with a single-mission (TMD only) test cruiser for Navy Theater Wide in FY2006 and operational capability consisting of two multi-mission cruisers with 50 missiles in FY2008. The deployment of a fully capable Navy Theater Wide system aboard multi-mission cruisers is not likely to occur before 2010 (four cruisers with 80 missiles).[10]

The year 2010 is a significant date for an upper-tier capability from a battle management perspective as well. THAAD and Navy Theater Wide will depend on data from the Space-based Infrared System Low (SBIRS-Low) to effectively engage the longer-range TBMs. SBIRS-Low will provide critical mid-course track data to the (hit-to-kill) upper-tier systems to allow them to accurately track and target longer-range TBMs. The first SBIRS-Low launch has been delayed two years until 2006, but DoD still projects a SBIRS-Low operational capability in 2010.[11]

Members of the Family: Lower-tier

Third in desirability is the lower-tier or point/area defense capability. The Family of Systems is developing three lower-tier systems: PAC-3, Navy Area Ballistic Missile Defense (Navy Area Defense), and MEADS. PAC-3 adds a new missile with a hit-to-kill warhead and enhanced radar to the existing Patriot air and missile defense system, providing improved point air and ballistic/cruise missile defense for troops and fixed installations.[12] Navy Area Defense program adds ballistic missile defense capabilities to Standard Missile 2 surface-to-air missile (SAM) —the Navy's primary anti-air warfare weapon—for the protection of ports and high values assets such as airfields that are located in costal areas. MEADS is a lighter-weight, tactically and strategically mobile replacement for the Patriot system that will use the PAC-3 missile as its interceptor. The U.S. intends to co-develop MEADS with other NATO countries (specifically Germany and Italy) to provide 360-degree air and missile defense for maneuver forces.[13]

The lower-tier systems remain essential but face a very difficult task. They are most susceptible to the terminal countermeasures an adversary could employ to thwart a defender, to include: corkscrewing the missile during reentry, deploying submunitions or penetration aids (terminal boosters and decoys), or even reshaping/redesigning the warhead to increase its reentry velocity or reduce its radar cross section.[14] All three systems are optimized for shorter-range missiles and would be challenged by the reentry velocities of high performance medium and longer-range missiles. The post-intercept debris that lower-tier intercepts will produce should not be of significant consequence for the physically protected and NBC-protected troops that these systems are primarily designed to defend, but may be of concern for unprotected civilians.

The scheduled fielding of the lower-tier systems is no less problematic than other members of the Family of Systems. PAC-3 deployment is relatively straightforward. In the fourth quarter of FY2001, the first Army Patriot battalion will receive PAC-3 missiles (16 missiles). PAC-3 should go into full production in FY2002 and the only questions that remain are how many missiles and at what rate/price.[15] Navy Area Defense is slightly more complicated. Presently, it appears that the planned deployments of Navy Area Defense will slip an additional 13 months.[16] Previously, a first cruiser was planned to be operational in FY2003 and the deployment complete by 2005. Any predictions about MEADS deployment at this stage in the program's development would be highly speculative, for the U.S. still does not have a firm commitment from European partners.[17] Ballistic Missile Defense Office (BMDO) testimony maintains that a contingency capability could be fielded by FY2010 and a MEADS limited operational capability by FY2012.

Uncertainty regarding MEADS deployment schedules should not, however, be interpreted as uncertainty regarding the overall worthiness of pursuing the MEADS program. MEADS is the only TMD system that can be moved by theater airlift assets alone (U.S. C-130s and European C-160s) and has been designed to roll off of transports and immediately begin operations. Perhaps more important for a nation like the U.S., which must project its military power across the globe, is MEAD's strategic mobility. A Patriot battalion's airlift and or sealift deployment requirements are quite large—4400 short tons equivalent requiring eighty five (85) C-17/C-5 sorties to deploy—roughly equal to the requirements for approximately 135-175 combat aircraft.[18] MEADS' significantly reduced deployment requirements—43% of the Patriot system—is an objective worthy of pursuit, especially in light of recent studies highlighting shortfalls in U.S. strategic lift capabilities.[19]

TMD Family of Systems: Concluding Assessment

This discussion of the Family of Systems seeks to emphasize one simple point that is often obscured in technical discussions of U.S. theater missile defense: the Family of Systems will not be able to deliver the defense capability that it was designed to provide for almost another decade, even under the most optimistic acquisition timelines.[20] The Family of Systems approach calls for a minimum of two layers of defense—a lower-tier and an upper-tier—with the addition of a highly desirable third layer—boost-phase intercept—as soon as technically feasible. However, the U.S. military is only just beginning to field a lower-tier capability with PAC-3, and this capability will be fragmentary until deployed in sufficient numbers[21] and supplemented by Navy Area in the FY2005-2006 timeframe. While the U.S. military and its coalition partners may enjoy some degree of protection from the Israeli Arrow II when deployed in the Middle East, a deployable U.S. upper-tier capability is not likely prior to FY2008. This upper-tier capability will be rudimentary until the space-based sensors that these systems require for full exploitation of high-altitude intercept capabilities become operational in the FY2010-2011 timeframe.

Table 3. Theater Missile Defense Systems Deployment Schedule[22]

FY	01	02	03	04	05	06	07	08	09	10	11	12
ARROW UT	2 Batteries											
PAC-3 LT (1998-99)*	F PAC-3 Production: 90-100 Missiles/Year Missiles											Complete (724-1098 Missiles)
Navy Area LT (1999)*	*Missile* 13 Month Slip Pending		First Missiles		Complete 21 Cruisers							
Navy Theater UT (2002)*						Test Cruiser Contingency Capability (Block IA)		2 Cruisers/ 50 Missiles (Block IB)		4 Cruisers/ 80 Missiles (Block IC)		
THAAD UT (2001)*							FUE (CI)				FUE (CII)	
MEADS LT (2005)*										*IOC?*		*FUE?*
ABL BPI (2005)*			Lethality Demon-stration	*Acceleration Decision*		*FUE 1 Aircraft (Accelerated)*		*IOC 3 Aircraft (Accelerated)*		IOC 3 AC *Complete 7 Aircraft (Accelerated)*		Complete 7 Aircraft

LT=Lower-tier UT=Upper-tier BP=Boost-phase intercept *=date projected for IOC in 1998 FUE=First Unit Equipped IOC=Initial Operational Capabilit

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[1] Information contained in this chapter comes from a variety of sources: Ballistic Missile Defense Organization (BMDO) Fact Sheets, which were used for basic information but are terribly out of date; Federation of American Scientists (FAS) website, which had valuable program history and links to Congressional testimony; JTAMDO briefings, meeting notes, and newsletters, which were a valuable source on changes to programs; BMDO Director testimony; and industry/press reporting. Particularly useful from industry/press reporting is Hewish, Mark, "Raising the Ballistic Missile Shield: The Latest Advances in Ballistic Missile Defense are Emerging," *Jane's International Defense Review*, vol. 33, no. 9 (Sep. 2000), p. 30-35.

[2] The PAC-2/GEM incorporated guidance improvements to the PAC-2 missile to enhance the effectiveness of its blast-fragmentation warhead against Scud-class ballistic missiles. The U.S. Army has fielded approximately 350 PAC-2/GEM missiles since February 1995. The new PAC-3 missile is smaller and more agile than the PAC-2 missile and employs a "hit-to-kill" mechanism of lethality. The U.S. Army is scheduled to field sixteen (16) PAC-3 missiles, one radar, and one fire control station in late 2001. PAC-3 will, however, supplement, not replace existing PAC-2 capabilities and a Patriot PAC-3 Battery will employ a mix of PAC-2, PAC-2/GEM, and PAC-3 missiles. The Long-term PAC3 deployment consists of the replacement of PAC-2 missiles in three of the eight launchers in each Patriot battery with PAC-3 missiles (battery load out will be 48 PAC-3 and 20 PAC-2 missiles); initial (baseline) deployment will be 2 launchers per battery (32 PAC-3 and 24 PAC-2 missiles). If recent tests are indicative of intercept operations, the PAC-3 would be used against Scud-type and more sophisticated missiles (with two PAC-3 interceptors launched for each incoming missile to increase the probability of a successful intercept) and PAC-2 missiles would be used for shorter-range missiles such as the SS-21. See: U. S. Cong., House, Committee on National Security, "Statement of Lieutenant General Malcolm R. O'Neill, USA, Director, Ballistic Missile Defense Organization before the Committee on National Security, House of Representatives, April 4, 1995," on-line, internet, March 22, 2001, available from http://www.acq.osd.mil/bmdo/bmdolink/html/oneilltest.html; Dennis D. Cavin, "Transforming ADA: 'Plugging In' the Air & Missile Defense Force of the 21st Century," *Air Defense Artillery Magazine*, on-line, internet, March 22 2001, available from http://147.71.210.23/adamag/ADA%20Yearbook%202000/Transforming.htm; Michael Sirak, "PAC-3 On Track For First-Unit-Equipped In 2001," *Jane's Defense Weekly*, vol. 35, no. 1 (Jan. 3, 2001), p. 9; and Kent Faulk, "Army Says New Patriot Missile Test on Mark," *Birmingham News*, April 1, 2001, on-line, internet, April 2, 2001, available from http://ebird.dtic.mil/Apr2001/e20010402patriot.htm.

[3] While the U.S. participated in the funding and development of the Arrow system, it has no plans to acquire the system for U.S. forces. The Arrow II is currently deployed in Israel in two four-launcher batteries, both of which will eventually possess 50 missiles. A third battery will also be fielded. The Arrow II missile has an effective range of 16-48 km, at an altitude of 10-40km. Thus, its capabilities overlap those of the U.S. PAC-3 and Theater High Altitude Area Defense (THAAD) systems. Israel has been eager but unable to find a U.S. commercial partner for co-production of Arrow II missiles

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for export sales (due to legal concerns relating to the Missile Technology Control Regime). However, comments by a senior Israeli defense official seem to indicate that Israeli domestic production is having difficulties meeting both the quantity and quality that Israel requires for its own defense. Further complications for Arrow II production also may result from former-President Clinton's failure to secure the $750M in special economic and military aid for the Middle East from the U.S. Congress. Reports point to an Israeli desire to use most of their military aid money from these funds to boost Arrow II production. For background on the Arrow program, see Marvin Feuerwerger, "The Arrow Next Time? Israel's Missile Defense Program for the 1990s," Policy Paper No. 28 (Washington, D.C.: The Washington Institute for Near East Policy, 1991). On recent developments see Ann Roosevelt, "Israeli Missile Defense System Scores Again," *Defense Week*, September 18, 2000, p. 6; and Barbara Opall-Rome, "Arrow Production Turns Focus to U.S. Parts," *Defense News*, January 29, 2001, p. 3; and Barbara Opall-Rome, "Export Strictures Could Hamper U.S. Missile; Transfer to Allies," *Defense News*, January 29, 2001, p.3. Additionally, while Israel currently has no plans to purchase the PAC-3 system, Secretary of Defense William Cohen "pledged" the system to the Egyptians in March 1999 (Wade Boese, "U.S. Announces New Arms Sales To Middle East Worth Billions," *Arms Control Today*, March 1999, on-line, internet, March 26, 2001, available from http://www.armscontrol.org/ACT/march99/armmr99.htm).

[4] Joint Theater Air and Missile Defense Doctrine identifies four operational elements of TMD: actives defense; passive defense; attack operations; and command, control, communications and intelligence (C3I). On behalf of the Joint warfighting commands, the Joint Theater Air and Missile Defense Organization (JTAMDO) oversees the integration of existing TMD capabilities relating to these four elements and ensures interoperability of Service-developed systems. JTAMDO also oversees the development of operational concepts and requirements; system architectures; and investment strategies for TMD (important documents in this regard are JTAMDO's *Theater Air and Missile Defense Master Plan*, *Joint Theater Air and Missile Defense Mission Need Statement*, and the *Theater Air and Missile Defense Capstone Requirements Document*). JTAMDO addresses attack operations through the Joint Attack Operations Working Group (JAOWG). Within the Air Force, these functions are performed predominantly by the Requirements Directorate at Headquarters Air Combat Command and by the Aerospace Command and Control, Intelligence, Surveillance and Reconnaissance Center (AC2ISRC). The Ballistic Missile Defense Organization (BMDO) partners with JTAMDO to provide systems engineering and acquisition management for the TMD Family of Systems. For a good overview of the role of JTAMDO (and to a lesser extent, BMDO) in the Joint Theater Air and Missile Defense (JTAMD) process, and of the range of complex issues related to this process, see Herbert C. Kaler, Robert Riche, and Timothy B. Hassell, "A Vision for Joint Theater Air and Missile Defense." *Joint Forces Quarterly*, Autumn/Winter 1999-2000, pp. 65-70.

[5] BMDO is pursuing a second boost-phase intercept system—the Space-Based Laser. DoD is designing an Integrated Flight Experiment (IFX) vehicle to test the Space-Based Laser in 2012. The Airborne Laser is scheduled for a lethality demonstration in FY2003,

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after which DoD will decide if the program could be accelerated. An accelerated deployment could lead to a contingency capability (one aircraft) in 2006 instead of FY2008, Initial Operational Capability (three aircraft) in FY2008 instead of FY2010 and complete deployment (seven aircraft) in FY2010 instead of FY2012. See U.S. Cong., House, House Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, "Statement of Lieutenant General Ronald T. Kadish, USAF, Director, Ballistic Missile Defense Organization," September 8, 2000, on-line, internet, February 19, 2000, available from http://www.acq.osd.mil/bmdo /bmdolink/html/kadish8sep00.html and Daniel Gouré, "Charting a Path for U.S. Missile Defenses: Technical and Policy Issues," CSIS Report (Washington, D.C.: Center for Strategic and International Studies, June 2000).

[6] At this point in Airborne Laser development, no definitive conclusions can be reached concerning the disposition of the intercepted missile's warhead. Whether or not the warhead would be consumed in a potential detonation of the booster, or whether and how far the warhead might continue to travel are open questions.

[7] For a discussion of U.S. TMD technologies and countermeasures to TMD systems, see Codevilla, pp. 3-12; Gouré; and Richard M. Lloyd, "New Technology Counters Ballistic Missile Weapons," *Aerospace America*, vol. 38, no. 4 (April, 2000), pp. 26-27.

[8] Arrow II is also an upper-tier system and the Airborne Laser also can conduct upper-tier intercepts.

[9] THAAD dates are those reflected in BMDO and industry/pres reporting. Some documentation from JTAMDO shows a first unit equipped (FUE) in FY2008 and early operational capability (EOC) in FY2008. See Kadish.

[10] The Standard Missile 3, which will be used in Navy Theater Wide, is expected to mature more quickly than the AEGIS weapon system software. Thus, Navy Theater Wide expects to be able to field a TMD capability earlier by reconfiguring the cruisers for TMD missions only (Blocks IA and IB). Once software development has caught up, the Navy will field multi-mission cruisers (Block IC), capable of conducting TMD and air defense missions as well. See descriptions of NTW (and other systems) in U.S. Department of the Navy, "Vision…Presence…Power: A Program Guide to the U.S. Navy," 2000 Edition, on-line, internet, January 1, 2001, available from http://www.chinfo.navy.mil/navpalib/policy/vision/vis00/top-v00.html; see also, Kadish and "Navy Theater Wide TBMD: PE 0603868C," March 8, 2000, on-line, internet, January 12, 2000, available from http://www.fas.org/spp/starwars/budget/ peds_97/603868c1.htm..

[11] Congress' General Accounting Office, however, recently issued a report disagreeing with DoD's assessment: "…the SBIRS-low program is at high risk of not delivering the system on time or at cost or with expected performance." See U.S. General Accounting Office, *Space-Based Infrared System-low at Risk of Missing Initial Deployment Date*, GAO-10-8 (Washington, D.C.: GAO, February 2001).

SBIRS will replace the Defense Support Program (DSP) constellation that currently provides missile launch warning and space surveillance. SBIRS will add "significant capability to our TMD architecture. The global coverage of SBIRS-High, with improved

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sensitivity and revisit rates over DSP, will allow better launch point determination, missile trajectory determination, and impact point prediction. These improvements will also ensure we can continue to detect, track, and assess the increasingly complex ballistic missile threats being fielded. SBIRS-Low will provide critical mid-course track data to the battle manager to allow accurate targeting and engagement of hostile threats." U.S. Cong., Senate, Armed Forces Committee, Strategic Forces Subcommittee, "Statement of General Ralph E. Eberhart, USAF, Commander in Chief North American Air Defense Command and United States Space Command Before the United States Senate Armed Services Committee Strategic Subcommittee," March 8, 2000.

SBIRS has two space based components (plus its ground station and processors): SBIRS-High, consisting of a geosynchronous earth orbit (GEO) constellation (4 satellites for hemispherical coverage) and a highly elliptical orbit (HEO) constellation (2 sensors on host satellites for polar coverage); and the previously mentioned SBIRS-Low, a low earth orbit (LEO) constellation (approximately 24 satellites; precise number yet to be determined). The SBIRS-High first GEO launch was delayed by 2 years until FY2004. For more on SBIRS, see GAO, *SBIRS-Low at Risk*.

[12] This paper does not directly address cruise missile defense, which presents a different set of problems than that of the ballistic missiles, which the TMD Family of Systems is optimized to defend against (yet similar in many respect to defense against aircraft). A capability to intercept cruise missiles that some lower-tier members possess is an important feature. On cruise missile defense issues, see Igor J. P. Gardner, "Theater Land Attack Cruise Missile Defense: Guarding the Back Door" (Maxwell AFB, AL: School of Advanced Airpower Studies, Air University, June 1999).

[13] See Kadish. For an evaluation of the relative merits of the different TMD systems and of the redundancy in lower-tier systems, see Karl Mueller, "Flexible Power Projection for a Dynamic World: Exploiting the Potential of Air Power" in *Holding the Line: U.S. Defense Alternatives for the Early 21st Century*, ed. Cindy Williams (Cambridge, Mass.: MIT Press, 2001), pp. 211-252.

[14] PAC-3, in particular, with its limited effective range (20km; 15km maximum altitude) would have difficulty engaging an incoming missile before submunition release. However, without terminal guidance and flight control for these submunitions, release at this distance would result in such a broad (and unpredictable) dispersal of the payload as to render the weapon ineffective in use against military targets. See Codevilla, pp. 17.

[15] Although the PAC-3 is the "only variant of the Patriot missile that can fully meet military needs," the missile is very expensive. BMDO and the Army are attempting to shift the production schedule (forward) in attempt to reduce PAC-3 cost per missile "to about $2 million from current $5 million per missile." Full rate production begins in FY2002. BMDO's latest roadmap showed PAC-3 funded for only 240 missiles over the Future Years Defense Program (FYDP) and program total of 724 missiles. Daniel G. Dupont, "Pentagon Grants Army $900 Million For More Patriot Pac-3 Missiles," *Inside The Army*, January 22, 2001, p. 1, on-line, internet, January 21, 2001, available from http://ebird.dtic.mil/Jan2001/s20010122grants.htm.

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[16] One further complication for Navy Area Defense is foreseeable. Congress directed DoD to study the potential use of the PAC-3 missile as the interceptor in the Navy Area Defense program, believing that "the Navy Area program could possibly benefit from the hit-to-kill technology of the PAC-3 interceptor and that DoD might realize additional cost savings and logistical benefits from purchasing a common missile." DoD must deliver the study to Congress by April 15th of this year (2001). Thomas Duffy, "Navy Area Missile Defense Program Facing 13-Month Slip." *Inside Missile Defense*, November 29, 2000, p. 1, on-line, internet, November 29, 2000, available from http://ebird.dtic.mil/Nov2000/e20001129area.htm; and Jeff Bennett and Thomas Duffy, "Rempt: Navy Missile Defense Changes Do Not Shift Priorities," *Inside Missile Defense*, January 24, 2001, p. 1, on-line, internet, January 24, 2001, available from http://ebird.dtic.mil/Jan2001/s20010124rempt.htm.

[17] The formal contract award for MEADS, formerly expected in March 2001, is now projected for June 2001.

[18] During Operation DESERT SHIELD/STORM, the U.S. deployed two Patriot battalions to the Gulf region. The first Patriot Battalion was airlifted to Saudi Arabia and arrived on day 34. The second battalion arrived primarily via sealift on day 82. The U.S. also deployed two Patriot batteries to Israel during DESERT SHIELD, requiring 50 C-5 sorties and 48 hours to complete. More recently, for point defense the Army deploys Patriot "Minimum Engagement Packages" (MEP). A MEP consists of three of the battery's eight launchers, a streamlined tactical operations center, and a maintenance support team. The MEP deployment to Incirlik Airbase, Turkey from Germany in January 1999 required four (4) C-17/C-5 sorties.

To mitigate the lift requirements and increase responsiveness to developments in the Middle East, U.S. Central Command permanently maintains the equivalent of a Patriot battalion in the region. Patriot missile assets are deployed in Saudi Arabia, Kuwait, and Turkey at Riyadh, Dahran, Camp Darby, and Incirlik Airbase. (In addition to the Arrow II, Israel also fields four PAC-2 firing units with 120 interceptors). Jon R. Anderson, "U.S. Troops Deploy to Israel for Exercises," *Stars and Stripes*, January 27, 2001, p. 6, on-line, internet, January 28, 2001. Available from http://ebird.dtic.mil/Jan2001/e20010129usto.htm.

[19] The recently completed Mobility Requirements Study 2005 (MRS-05) determined that the military requires 54.5 million-ton miles per day of airlift to execute the current national military strategy through 2005. This requirement is 4.8 million ton miles per day more than the previously determined requirement—a requirement that the military is reportedly more than five million-ton miles per day short in currently meeting. On MRS-05 findings, see Frank Wolfe, "Mobility Plan Insufficient To Meet Military Strategy, Draft Study Says," *Defense Daily*, vol. 207, no. 16 (October 24, 2000), p. 5 and Frank Wolfe, "Mobility Study Foresees At Least Six More C-17s Than Planned." *Defense Daily*, vol. 209, no. 18 (January 29, 2001), n.p.

[20] Table 2 in the text includes the dates for the different systems Initial Operational Capability (IOC) as projected in 1998. Milestones in the deployment of the different systems have been moved back in the past (2-5 years since 1998) and are likely to move

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back yet more. As General Kadish, BMDO Director, and his predecessors have reminded us, the "aggressive" development/acquisition schedules of these programs results in a high degree of risk. See Kadish.

[21] PAC-3, once it enters full-rate production, is perhaps the only TMD program at this time whose operational deployment conceivably could be accelerated through additional funding. See Dupont.

[22] Table is derived from sources cited in notes above. 1998 projected IOC dates are taken from Schneider, *Future War and Counterproliferation*, pp. 138-39.

Chapter 5

The Sword: U.S. NBC/M Counterforce Capabilities

At the heart of the Defense Counterproliferation Initiative, therefore, is a drive to develop new military capabilities to deal with this new threat.[1]

—U. S. Secretary of Defense Les Aspin, December 1993

Since the Gulf War, the Defense Department has made substantial progress in developing NBC/M counterforce capabilities, particularly in conjunction with the Department of Defense Counterproliferation Initiative (CPI), launched in 1993. Progress is most evident in the area of NBC/M counterforce fixed target attack capabilities, where one can point to specific materiel solutions that have been fielded (weapons enhancements and software planning tools). Less tangible, nevertheless significant, progress has been made in the planning area of NBC/M counterforce mobile target attack capabilities, where non-materiel solutions have been emphasized (revised processes and architecture development; concept development). This chapter will highlight the significant developments in the NBC/M counterforce capabilities development, a well as some of the enduring capability gaps.

NBC/M Counterforce Fixed Target Capabilities

In recognition of the undesirable "target-generated collateral effects" associated with NBC/M fixed targets—the harmful effects that potentially could result from the release of hazardous substances from a facility—DoD has emphasized the development of decision making and analysis tools that would aid the commander in planning, executing, and assessing counterforce operations. Through Advanced Concept Technology Demonstrations (ACTDs), DoD has also investigated and fielded significant improvements to U.S. NBC/M counterforce fixed target attack capabilities.[2] Considerably less progress has been made, however, in the development of an Agent Defeat Weapon (ADW)—a capability to neutralize biological and chemical agents, or to deny access or freedom of use of associated weaponized delivery systems, while minimizing collateral damage. DoD efforts to improve NBC/M counterforce fixed target attack capabilities have sought to leverage existing special weapons development and targeting expertise resident in the National Laboratories, U.S. Strategic Command (USSTRATCOM), the Intelligence Community, and the Defense Threat Reduction Agency (DTRA; specifically those components that formerly constituted the Defense Special Weapons Agency, previously named the Defense Nuclear Agency).

Decision Making and Analysis Tools

One of the first tools to result from the combined efforts of these organizations was the Counterproliferation Analysis and Planning System (CAPS). Although its databases and models are far from complete, CAPS is designed to furnish a single source of information on and detailed analysis of NBC/M programs of a number of proliferating countries.[3] The Director of Lawrence Livermore National Laboratory described CAPS in testimony for the Senate as:

> … a powerful modeling system for analyzing the proliferation activities of foreign countries and evaluating the consequences of possible interdiction options, including environmental and socio-economic effects. With the

> CAPS we can model the various processes (chemical, biological, metallurgical, etc.), which others use to build weapons of mass destruction and their delivery systems. Drawing upon information from many sources, we can generate models of a specific country's proliferation activities. We can identify the function and location of suspected production sites, and in some cases we can even model the layout of the individual facilities. By modeling proliferation activities at this level of detail, we can analyze the country's specific approach to weapons production. We can then identify critical processing steps or production facilities, which if denied, would prevent that country from acquiring WMD.[4]

In short, CAPS is designed to supply comprehensive analysis of NBC/M programs from the earliest stages of research and development, through testing and production, to weaponization and stockpiling.[5]

A second tool that has been developed is the Integrated Munitions Effectiveness Assessment (IMEA)—a software tool for conducting weaponeering and collateral effects assessments of fixed NBC/M targets (buildings, bunkers, and tunnels). IMEA consists of two interactive modules that employ an iterative process to devise an optimal solution for the attack of an NBC/M target (type of weapon and fuze, impact point, day/time of attack). The Munitions Effectiveness Assessment (MEA) module calculates probabilities of structural and functional damage to a facility and the probability of hazardous material release.[6] Using its database of weapons and their characteristics, MEA generates two- and three-dimensional models of facilities, and evaluates weapon employment possibilities.[7] The second module, the Hazard Prediction and Assessment Capability (HPAC), determines the size, pattern, and potential effects of a hazardous material release (nuclear, biological, chemical, or radiological) from the facility. HPAC processes the spillage/release data received from MEA along with its own terrain, weather, and population data to predict hazardous material dispersal, subsequent effects, areas of contamination, population exposure, medical effects, and probabilities of casualties and fatalities. The accuracy of HPAC's predictions greatly depends on reliable weather data for the time of the attack.[8]

Attack Capabilities

While improvements in the precision attack capabilities of all the Services since the Gulf War have certainly enhanced general NBC/M counterforce capabilities, it has been the products of the three specific DTRA managed programs that have made the most significant contributions. The first of these programs (Counterproliferation-1; CP-1) was an ACTD focused on assessing and improving direct attack capabilities against fixed facilities. The second (ongoing) program is an ACTD emphasizing standoff attack capabilities. The third program is the ongoing Hard and Deeply Buried Target Defeat Program (HDBTD).

The first of the ACTD programs found that weapons, fusing, and delivery techniques required improvements in order to defeat fixed facilities with low to zero collateral effects. The ACTD demonstrated that existing means remained capable of defeating (severely damaging through blast) above ground and near-surface hardened facilities, but that the undesirable target-generated collateral effects resulting from such an attack would likely be highly pronounced. Most all of the agent stored in the targeted facility likely would be spilled as the result of such an attack. The ACTD determined that in order to mitigate the collateral effects, the best solution for the attack of "soft" targets (such as buildings) was to collapse the structure and bury the agent. This could best be accomplished by fusing a weapon to penetrate beneath the floor of the building before detonation. For "hard" targets (bunkers), the ACTD found that less damage to the structure itself was actually better. The objective for hard targets should be to achieve a "functional" kill, using a smaller warhead whose explosion would be sufficient to spill the agent but not large enough to severely damage the structure. The structure itself would contain most of the agent.[9]

The ACTD developed and delivered two primary systems to improve soft and hard target defeat capabilities: the Hard Target Smart Fuse (HTSF) and the Advanced Unitary Penetrator (AUP).[10] HTSF permits the optimization of a warhead's burst location within or below a facility and can be used in conjunction with a number of warheads currently in the inventory and under development. In addition to providing a time delay, HTSF can "count" hard layers and voids and calculate distance traveled to allow for detonation within a specified floor or level or depth below a NBC facility.[11]

The AUP is a "penetrating" warhead, designed to enhance capabilities against hard (and deeply buried) targets. AUP provides approximately twice the capability as standard (2000lb) warheads to pass through earth, rock, and concrete, and achieves this with a smaller explosive charge (1700lb) that further minimizes collateral damage. Previously, only the mammoth GBU-28 and the GBU-37 (with 4000lb class, penetrating warheads) could achieve such penetration, and only the F-15E and the B-2 (respectively) could carry these weapons.[12] AUP allows a wider variety of Navy platforms to attack hard and deeply buried targets, to include: A-10, F-16, F-15, F-14, F/A-18, and F-117. However, only the U.S. Navy has taken delivery of AUP and certified it for use with its aircraft (F/A-18 and F-14).[13]

The second of the ACTD program seeks to provide the same type of fusing and penetration enhancements to NBC/M counterforce standoff capabilities. The ACTD has already integrated these enhancements into the Air Force's Conventional Air Launched Cruise Missile (CALCM) weapon system and is continuing work on the Navy's Tactical Tomahawk Land Attack Missile (Tactical TLAM) that is under development. The ACTD is also assessing the capabilities of the Air Force's version of the Joint Air to Surface Standoff Missile (JASSM) to conduct NBC/M fixed facility attack.[14]

Since penetrating weapons—such as those employing AUP with HTSF—often produce less external and surface damage, the first ACTD also developed a system to aid in battle damage assessment. This system, the LANTIRN Bomb Impact Assessment Modification (LANTIRN BIAM), adds a radiometer and a digital recording system to the LANTIRN targeting pod that the Air Force and Navy already extensively use for delivering laser-guided munitions.[15] The radiometer provides infrared (thermal) imagery of a weapon's impact and plume and of any subsequent venting from the target. Using this data, planners can determine whether the weapon was a dud, a miss, or a hit and whether the weapon successfully penetrated a hardened structure and detonated inside or below it. The Air Force is currently modifying 43 pods (in addition to the single pod developed during the ACTD) for fielding.[16]

The Deeply Buried Target Challenge

The third program is the Hard and Deeply Buried Target Defeat Program, which emphasizes tunnel or deep underground facility defeat. Whereas the previous two ACTDs have ensured that near-surface hardened facilities (reinforced concrete bunkers) remain vulnerable to U.S. conventional weapons, tunnels continue to present a challenge. This challenge was highlighted in 1996-97 when Dr. Harold Smith, the Assistant to the Secretary of Defense for Nuclear, Chemical and Defense Programs, revealed that the

Libyan deep underground chemical production facility at Tarhunah was invulnerable to U.S. conventional weapons and that an earth-penetrating warhead enhancement was required for the B-61 nuclear weapon to continue to hold the facility at risk.[17] Stephen M. Younger, the Associate Director for Nuclear Weapons at Los Alamos National Laboratory, recently reemphasized the challenge of deep underground facilities in testimony to Congress: "Some very hard targets require high yield to destroy them. No application of conventional explosives or even low-yield nuclear explosives will destroy such targets, which include hardened structures buried beneath hundreds of feet of earth or rock."[18]

The Intelligence Community and weapon developers have long recognized the deep underground facility challenge but the challenge has become even more alarming in recent years. Former adversaries such as Nazi Germany and the Soviet Union used mines and natural caverns to conceal and protect vital military production and functions during World War II. During the Cold War, the Soviet Union excavated a large number of elaborate deep underground facilities for leadership protection in case of nuclear conflict. However, U.S. military planners generally considered these facilities to be exceptional cases; the number of near-surface (excavated and covered) reinforced concrete bunker facilities dwarfed the number of deep underground facilities. The idea of developing conventional weapons for the defeat of deep underground targets remained impractical and prohibitively expensive, if not unnecessary from the perspective of the national military strategy.

In the past decade, two developments have precipitated the renewed attention that such programs as Hard and Deeply Buried Target Defeat Program are focusing on the deep underground challenge. First, the intelligence community has indicated that potential adversaries have turned to tunneling into mountainsides instead of constructing bunker facilities as the preferred method of hardened facility construction.[19] Simply stated, the number of deep underground facilities has increased significantly and is expected to continue to grow. Second, further evidence indicates that potential adversaries are using these tunnel facilities for NBC/M production and storage.[20]

The Hard and Deeply Buried Target Defeat Program's primary contribution has been the recognition that U.S. conventional capabilities against deep underground targets are, indeed, better than originally suspected. Clearly, the destruction of some deep underground facilities with conventional weapons remains beyond our means despite earth penetrating warheads and precision delivery techniques that allow for the sequential application of weapons in the crater dug by the preceding weapon ("consecutive miracles").[21] However, the functional defeat of many of these facilities is possible. Using conventional weapons currently in the inventory, it is possible to collapse entrance/exit portals to some underground facilities. This could effectively deny access to and use of the NBC/M assets stored in the facility for at least several days, depending on the amount of ruble blocking the portal and the availability of heavy equipment to excavate the portal from the exterior or to tunnel out from the interior.[22]

Agent Defeat

While the Hard Target Smart Fuse and Advance Unitary Penetrator provide for NBC/M fixed facility attack with a significant reduction in undesirable target-generated collateral effects, even a small release of an agent may be unacceptable for some NBC/M operations. A small release from a targeted facility located in an urban area could result in a large number of civilian casualties. Depending on weather conditions, a small release from a targeted facility located near a geographical border with a third party might result in prohibitive political consequences. For situations such as these, and for reliable defeat of agents under a broad range of conditions, the Air Force has been pursuing the development of an Agent Defeat Weapon—a warhead technology capable of destroying, disabling, or denying the use of chemical and biological agents in facilities and stockpiles with minimal agent dispersion. Preferably, the agent defeat capability would be realized by means of a single "fill" that could be fitted to existing and planned delivery systems and munitions.

Unfortunately, no concepts that the weapons laboratories have evaluated to date have offered an improvement over high explosives.[23] The process has been slow (and under funded) and has screened and discarded all but 8 of 58 original concepts (as of November 2000). Concepts that have been evaluated and discarded include: foams, liquid ozone, super bleach, and an array of conventional explosive (timed to detonate simultaneously). Recent press reports indicate that the weapon concepts still being evaluated employ heat, ultraviolet radiation, oxidizers, and enzymes as defeat mechanisms. [24]

NBC/M Counterforce Mobile Target Capabilities

NBC/M mobile targets comprise a subset of a larger set of targets known as Time-sensitive or Time-Critical Targets. Time Critical Targets are targets that have been identified in advance by the Joint Force Commander as demanding a time-urgent military response upon detection, because they pose an immediate and serious threat to friendly forces, yet may be vulnerable to attack for only a brief period of time.[25] Generally, the target types typically considered to be Time Critical Targets include NBC weapons and their delivery means; theater ballistic missiles and cruise missiles; mobile surface-to-air missile systems; and aircraft. Of these target types, it is the NBC/M mobile targets that continue to most seriously challenge U.S. capabilities.

The short window of vulnerability of NBC/M mobile targets places tremendous demands not only on weapon systems at the end of the "kill chain" that perform the actual attack, but on the entire enabling support structure of intelligence, surveillance and reconnaissance (ISR) and battle management, and command, control, and communications (BM/C3) systems as well.[26] All components in this system must perform their functions (mission planning, target detection, target tracking, target identification, weapon allocation, target engagement, post-attack assessment) at maximum efficiency for the overall system to be able to successfully engage NBC/M mobile targets within their short window of vulnerability. Moreover, a process and architecture is required to integrate these component systems and their functions and to facilitate responsive action.

However, in reality, it is difficult (and costly) to maximize the efficiency of TCT component systems and to integrate them, for there are no dedicated TCT component systems and the process and architecture have yet to fully mature. TCT must leverage existing multi-mission capabilities that contribute to the TCT mission, but are not optimized for this purpose. Thus, capability gaps or "needs" remain and process improvements must continue.

NBC/M Counterforce Mobile Target/TCT Capability Gaps

Warfighting commands and service planners have done a thorough job of identifying and analyzing the capability gaps—or unfilled needs—of NBC/M mobile targeting. With regards to intelligence, reconnaissance, and surveillance these needs consistently include: intelligence preparation that supports pre-launch operations; long-endurance, wide area surveillance; rapid sensor retasking; precise target location, tracking, classification, and identification; data exchange and cross-cueing between sensors; and foliage penetration. With regards to battle management and command, control, and communications the needs consistently include: rapid data exchange between platforms; automated battle management tools for data fusion, target tracking, and tasking (Dynamic Battle Management); a common view of the battlespace (Common Operational/Tactical Picture); and integrated fire control of service platforms. Finally, regarding weapon systems the needs consistently include: ability to acquire, identify, engage targets in adverse weather/environment; highly responsive weapons accepting in-flight target updates and capable of employing automatic target recognition; and weapons capable of neutralizing NBC agents.

NBC/M Counterforce Mobile Targets /TCT Capabilities Enhancements

Identifying and assessing these shortfalls is quite different from funding and executing programs to correct them. The discussion that follows will address some of the significant steps that have been taken to close the NBC/M counterforce mobile target attack capability gaps.

First, regarding ISR needs, TCT is likely to see significant improvements in wide area surveillance with the fielding of the reconnaissance UAV Global Hawk. To what degree wide area surveillance (WAS) capability improves will depend on the continued evolution of Global Hawk's sensors, which are still under development; how long the Air Force retains the U-2 aircraft in service, which many believe Global Hawk could replace;[27] and what upgrades the Air Force provides to the Joint Surveillance Target Attack Radar System (JSTARS).[28]

Four Global Hawk demonstrators have been built for training, exercises, and limited operational use; however, only one complete sensor system is available. The Air Force could have as many as 40-50 Global Hawks by 2010, but Secretary Peters has decided that funding should emphasize sensor development instead of platform procurement. According to the current plan, Global Hawk procurement will likely remain at two vehicles per year through FY2006. Then the buy will increase to four air vehicles in FY2007 and six in both FY2008 and FY2009. The current ACTD Global Hawk sensor is a mechanically scanned planar array antenna capable of operating in both the Synthetic Aperture Radar (SAR) mode and Ground Moving Target Indicator (GMTI) mode to provide near-real-time, on-demand area search imagery and high resolution imagery of selected point targets during day, night and in all weather conditions.[29]

Also regarding ISR, in the mid-term, mobile target tracking and classification capabilities will be enhanced through the Multi-Platform Radar Technology Insertion Program (MP-RTIP). MP-RTIP is developing a new radar employing fourth generation, airborne phased array antenna technology and commercially available digital signal processing technology to replace the current Global Hawk radar and to field on a yet-to-be determined manned platform. Currently, MP-RTIP plans to produce radars for forty-five platforms: forty Global Hawks and five manned platforms. Unfortunately, MP-RTIP is in the early stages of development and under the current development schedule will not be available until 2009 for Global Hawk and until 2012 for a manned wide area surveillance platform.[30]

To aid in the local detection and location of mobile missiles, the U.S. Special Forces Command has fielded an unattended ground sensor ("Steel Rattler") to monitor fixed sites, lines of communication, and choke points. The sensor was developed through an ACTD and has been very successfully demonstrated in several exercises since its debut in ROVING SANDS 1997. "Steel Rattler" has both acoustic and seismic sensors for target detection; a signal processor and acoustic signature database for target identification; Global Positioning System (GPS) for identifying its own location; a communications transceiver for reporting the target and location information back to a monitoring center; and a battery for a minimum of six months field life.[31] The Air Force has been tested an air-deliverable version (Advanced Remote Ground Unattended Sensor—ARGUS) that it plans to put in production by FY2002, with a 2003 initial operational capability date.[32] Ground sensors such as these expand the mobile missile's window of vulnerability, by providing a means to detect TELs (and possibly other equipment) before they even stop to prepare for a launch.[33]

Regarding BM/C3, the picture is more positive, especially for rapid data exchange, but only after years of delay resulting from funding shortages. The Air Force has finally begun to seriously fund and field Link 16—a jam-resistant, secure digital data transfer and network capability.[34] Link 16, also known as TADIL J, is DoD's primary tactical datalink for command, control, and intelligence. The Link 16 network provides real-time connection of ISR systems, battle management systems, and attack assets, allowing for sharing of target, threat, and intelligence information. Specifically, with regards to NBC/M mobile targets, Link 16 delivers both immediate mobile missile launch and location notification (in a standard data format) and off-board ISR sensor data to Air Force and Navy attack assets, to facilitate a rapid counterforce response.[35]

The Air Force has long recognized the tremendous benefits of Link 16, but it has found difficulty coming up with the funds to upgrade data links. As noted by one Air Force officer in his evaluation of data link potential in 1997: "The idea that there is a single aircraft sent into combat without the threat information capabilities offered by TADIL J [Link 16] or its equivalent seems reprehensible."[36] Even though General Michael Ryan, the Air Force Chief of Staff, has had as a goal the fielding a TCT capability for all platforms by FY2005, the Air Force has carried Link 16 as an (top) unfunded priority for several years.[37]

The Joint Expeditionary Force Experiment (JEFX) and ROVING SANDS exercises have demonstrated the value of data links (and concepts such as the TCT Cell, see below) and have helped keep the issue in front of senior leadership.[38] JEFX 2000, which took place last September, was particularly vocal about its accomplishments in this area:

> "That [data links] worked wonders. Several times our F-15Es had information about Scud launchers passed to them via data link tracks, and they were on top of the [launchers] inside of 15 minutes. We know we have the capability now to detect, locate, and destroy [mobile missiles] in real time. We proved it several times –and it was very impressive."[39]

The overall impression after the exercise was that data links would assist in bringing TCT down to "single minutes" in the near-term.[40]

Link 16 integration for fighter aircraft is proceeding but whether and which bombers will get Link 16 remains an open question.[41] Link 16 integration in the Air Force began with the F-15 A\C\D air superiority aircraft and has since progressed to the F-15E strike aircraft. As of the time of writing, the Air Force had completed the upgrade of approximately 50 F-15Es and plans to finish the remainder of the fleet by the end of FY2001 (total of 130 aircraft). F-16 integration is programmed to follow.[42]

Another significant development for BM/C3, yet still only a concept under development, is the TCT Cell. The TCT Cell is a concept for an organization whose dedicated purpose is to execute TCT. A prototype TCT Cell received acclaim in JEFX 2000 but the concept also has been explored and refined in Joint Experimentation efforts and exercises and the Joint Advanced Warfighting Program.[43]

The core function of a TCT Cell—matching on-call weapons to targets—places this concept under BM/C3. How the concept develops, however, will have significant implications for the development of intelligence, surveillance, and reconnaissance capabilities as well. If the TCT Cell evolves along the narrower lines of a weapons directing function—tasking available weapon systems based on an external target nominations—the implications are less significant. The TCT Cell would still drive requirements for such capabilities as fused sensor information and improved target identification. If the TCT Cell evolves along more comprehensive lines encompassing both targeting and execution functions—directing the search for TCTs, nominating targets, and tasking available weapon systems—the implications are much more significant. In addition to fused sensor information, the TCT Cell would require sensor models and planning tools, area limitation analysis tools, and the capability to redirect sensors. This second possible evolution would take the TCT Cell more in the direction of predictive analysis based on pre-conflict planning and would move TCT (NBC/M counterforce mobile target attack) closer to proactive (versus reactive) operations.

JEFX 2000 demonstrated the benefits of the second evolutionary path of the TCT Cell, but it still remains too early to say if and how the TCT Cell might develop.[44]

In the third general capabilities area—weapon systems—the development and fielding of weapon systems to fill TCT/mobile missile capability gaps has been disappointing. In conducting NBC/M counterforce mobile target attack today, U.S. forces would still have to rely on unguided munitions and a family of precision-guided munitions developed for fixed target attack. Moreover, the vast majority of these weapons (both in type and quantity) are shorter-range weapons, which may not provide the range or standoff capability needed in more demanding environments.[45]

The Services do have several weapons at various stages of development that they have identified as key systems for TCT/mobile missile attack. These developmental systems include the Army's Brilliant Anti-armor Technology Pre-planned Product Improvement (BAT P^3I) submunition for the Army Tactical Missile System (ATACMS) Block II missile; the Navy's Tactical Tomahawk, Extended Range Guided Munition (ERGM), and Land Attack Standard Missile (LASM); and the Air Force's Low Cost Autonomous Attack System (LOCAAS). However, as will be highlighted in the discussion below, only two of these systems—the Navy's Tactical Tomahawk and the Air Force's LOCAAS—significantly enhance mobile missile attack capabilities.

The Army is developing the BAT P^3I submunition to provide the ATACMS Block II missile an improved capability against moving (and stationary) targets, to include missile launchers as well as armored vehicles. The BAT P^3I submunition employs an acoustic sensor to initially seek out moving targets. Once a moving target is detected and located with this sensor, the terminal acquisition and engagement is accomplished with BAT

P^3I's dual mode seeker (imaging infrared and millimeter wave high frequency radar). If no acoustic signature is detected (*i.e.*, a stationary target), BAT P^3I scans the area with its imaging infrared and millimeter wave seeker. BAT P^3I's dual mode seeker enables ATACMS/BAT P^3I system to perform in near all weather, day/night conditions and against countermeasured targets. Testing has yet to fully evaluate the capability of the BAT P^3I seeker against missile launchers. ATACMS Block II missiles can deliver 13 BAT submunitions out to a range of 140km. Although the BAT P^3I submunitions is a promising enhancement to mobile missile attack capabilities, the range of the Block II missile severely limits the value of the BAT P^3I/ATACMS as a mobile missile attack system.[46] The Army is currently testing the BAT P^3I and projects production of BAT P^3I to commence in FY2003 and an initial operational capability for BAT P^3I in FY2005.

The Navy is developing and fielding three systems that it identifies as key TCT/mobile missile weapons. The Tactical Tomahawk—the most recent evolution of the TLAM—has been designed with a capability to be diverted to secondary pre-planned targets, an in-flight retargeting capability, a capability to loiter, and a 1500nm nominal range.[47] While the missile is in a loiter pattern, a command platform can retarget the Tactical Tomahawk missile to an aimpoint that was not loaded in the missile prior to launch. The missile receives the new targeting data (GPS coordinates) and uses its own on-board mission planning capability to plan a route to the new target. The Navy plans to purchase over 1350 Tactical Tomahawks beginning in 2003.[48]

The Navy tested the Tactical Tomahawk TCT/mobile missile concept during the Fleet Battle Experiment Golf in the Mediterranean (April 2000). Navy SEALs identified a mobile target and sent its coordinates to an orbiting P-3. The P-3 took strike control of the loitering Tactical Tomahawk (simulated by the Advanced Propulsion Lab by satellite link) and retargeted the missile. Planning work during the Experiment indicated that the planning and execution time for a TCT strike with a loitering Tactical Tomahawk (target detection to time-over-target) could be reduced to 26 minutes.[49]

The other Navy systems—ERGM and LASM—lack the range of the Tactical Tomahawk but are highly responsive systems that aid in TCT/mobile missile defeat. ERGM is a rocket assisted, GPS-guided projectile fired from the Navy Aegis Cruiser's Mk 45 Gun. It is highly responsive, all-weather fire support system with a 63nm range. The projectile's fly out time to 40nm is approximately 2.5 minutes. However after 40nm the projectile must glide to its target and the fly out time to 63nm is 7 minutes. ERGM is currently effective against static targets only, but the program contains the option for a pre-planned product improvement for mobile targets. ERGM begins low rate initial production in 2001 and the Navy will begin fielding the projectile in 2002.[50]

The LASM is also an all-weather, highly responsive surface attack weapon. LASM is the land attack variant of the Navy's supersonic Standard surface-to-air missile (SM-2), with GPS guidance and a reported range 150-200nm range. It's warhead (Mk125) is significantly more lethal than the ERGM—delivering the same net weight of explosives as 25 ERGMs—and has a fly out time of approximately 9 minutes out to this reported maximum range.[51] LASM will reach an initial operational capability with the fleet in 2004 and the LASM program does not currently include any preplanned product improvements at this time.[52]

As its name would imply, the Air Force's LOCAAS is an affordable precision attack munition capable of broad area search for TELs (as well as a range of other mobile targets) and of autonomous detection, identification, and destruction of TELs.[53] LOCAAS has been under development since 1990, when it began as a joint Army-Air Force anti-armor and interdiction technology concept. Since then, it has evolved from a gliding munition with a single-mode warhead into powered munition with a multi-mode warhead.

As currently envisioned, LOCAAS is a turbojet powered, GPS navigated, and Laser Detection and Ranging (LADAR) guided munition. It has a 90-100+nm range (30 min powered flight) that can be used for standoff, range extension from dispense point, and or target search.[54] When the LADAR sensor identifies a target, its automatic target recognition (ATR) processor selects the optimum warhead functional mode for target attack based on the hardness of the target: a long rod penetrator, an aerostable slug, or fragments. LOCASS then over flies its target for attack. In the case of a TEL, it could form a fragmentation warhead to attack the missile itself or an aerostable slug to attack the vehicle. The aerostable slug could be directed against an aim point in the rear of the vehicle to reduce the probability of debris damaging the missile warhead and to minimize other potential undesirable collateral effects (missile fuel release or a secondary explosion).[55]

NBC/M Counterforce Capabilities Development: An Appraisal

In the ten years since the U.S. received its NBC/M warning call in the Persian Gulf War, progress in fielding an effective NBC counterforce capability has been significant, if uneven. In fact, NBC/M counterforce progress could be considered quite remarkable, in light of the relatively low priority and modest resources that have been given to counterforce as part of DoD's counterproliferation efforts over the last eight years.

Among DoD's counterproliferation priority areas—the "Areas for Capability Enhancements" (ACEs) identified and prioritized by the warfighting commands—counterforce has faired poorly overall (see Table 3, below and Appendix A).[56] Interesting to note is the relatively high ranking of "hard and deeply buried target defeat"—the area of NBC/M counterforce in which quite substantial progress has been made—in contrast to the low ranking of "prompt mobile target detection and defeat"—where progress has been less substantial.[57]

Table 4. Areas for Capabilities Enhancements (ACEs): Select Yearly Rankings[58]

YEAR ACE*	1996	1997	1998	1999	2000
Hard & Deeply Buried Target Defeat	4	3	3	11	8
Agent Defeat Weapon	9	2	2	12	10
Mobile Target Defeat	10	12	12	13	11

*14 Total ACEs in 2000

Priority does not directly equate with investments, but with respect to investment counterforce still has fared poorly.[59] DoD continues to budget the "overwhelming bulk" of its NBC/M counterproliferation investment into active defense (ballistic and cruise missile defense—FY2001: 72%), followed in distant second by passive defense (14%).[60] Counterforce receives but 4%. In FY2001, the area "Prompt mobile missile detection and defeat" received no direct funding (0.0%), and DoD notes that funding for mobile target defeat is included other areas, predominantly under counterforce (already included within that 4%).[61] While it is true that many of these counterproliferation programs benefit multiple capability areas, the fact that mobile missile defeat receives no funding as an independent capability area is quite indicative of the overall level of resource commitment to mobile target defeat under the Counterproliferation Initiative. This level of resource commitment has been evident since the first DoD counterproliferation report (1994), which noted, in examining where additional funding would be required, that mobile detection and defeat was already "adequately funded."[62]

The low priority given to counterforce—specifically mobile missile defeat—is partially attributable to the view that needs in this area will be filled as part of Service efforts to meet broader warfighting goals. As DoD states: "It must be emphasized that counterproliferation efforts leverage the substantial investments made in maintaining the requisite military forces and defense infrastructure necessary to provide for the basic common defense of the US."[63] This view, however, seems to run counter to the original approach of the Counterproliferation Initiative that maintained that existing (Service) processes and funding levels were inadequate for addressing counterproliferation capability gaps.[64] As noted by Jerome Kahan, back in 1994: "It is not correct to assume that such [counterproliferation] capabilities would automatically be subsumed within a force structure designed to deter larger nuclear threats or to prevail in major regional contingencies facing conventionally armed opponents."[65] Furthermore, this view ignores the harsh realities of declining research and development budgets, which force the Services to design systems to meet broader rather than unique requirements and leave little for programs that are not directly related to primary mission areas.

This lack of priority—both conceptual focus and resources—may substantially explain the limited progress in closing the NBC/M mobile targeting gaps. Consider the weapons that the Services have identified for mobile missile defeat. Of the five weapon systems that the Services have identified, only one—LOCAAS—with its area search and independent target acquisition capabilities, provides an effective capability against mobile targets operating deep in enemy territory.

The Army designed the ATACMS/BAT P^3I combination for the attack of armored formations (groups of vehicles), which if moving would have a relatively predictable movement rate and azimuth. Although BAT P^3I can accommodate target location uncertainties due to error or some degree of target movement, as an unpowered submunition its area search capabilities are rather limited. Moreover, BAT P^3I, after a (likely) successful test against a TEL, would still require a highly responsive, long-range delivery vehicle. The range of the ATACMS Block II missile (140km) is insufficient in this regard.

The Navy has designed ERGM and LASM for Naval Surface Fire Support (NSFS). The primary purpose of Naval Surface Fire Support is providing long-range, accurate fires to support amphibious forcible entry operations. The new amphibious operational concepts such as "Ship to Objective Maneuver" (an outgrowth of *Operational Maneuver from the Sea*) require extended range, accurate, responsive, and highly lethal systems.[66] The primary customers for fire support are ground forces in contact, and the primary targets are stationary point or area targets. In fact, the fire support concept for ERGM emphasizes:

> For indirect, non-terminally guided fires to seriously damage a target, the target should remain stationary or move very little…. Effectiveness requires accurately predicting the target's time of arrival at a predetermined location. NSFS can be effective against moving targets if the overall movement of the target during time of flight can be reasonably predicted (movement restricted to a road or transit of a known choke point) or if the target's movement can be stalled temporarily…. ERGM is more suited for employment against targets whose location has been well defined (we know where the target is, although it may move) because time of flight and the absence of a terminally guided munition capability makes

> the engagement of moving targets less effective. Controlling the delivery of naval fires…to attain a specific time of impact on target (time on target), does, however, enable moving targets to be more effectively engaged, and enhances surprise and shock.[67]

The increased responsiveness and accuracy of ERGM and LASM clearly enhance capabilities against "relocatable" targets—targets that have recently moved but are now stationary. They also provide a degree of improvement in capabilities against a narrow range of mobile targets—those mobile targets located within approximately 150nm of the coast, whose precise geo-location can be obtained and whose movement (rate and azimuth) can be predicted. Without system upgrades and new warheads/submunitions, ERGM and LASM cannot hold mobile (moving) targets at risk.[68]

LOCAAS, as a matter of fact, is a mobile target weapon system. LOCAAS' wide area search capability and LADAR seeker allow it to find and destroy moving targets. Unfortunately, the Air Force has had, and continues to have, difficulty internally mobilizing support for LOCAAS and mobile target defeat.[69] The development of LOCAAS has been hindered by funding shortages, a lack of Joint support, and a decision not to proceed with the program as an ACTD in 1998.[70] The program now faces further delays as a result of a "restructuring" of the program under which it is being developed (Miniature Munitions Capability program into the Small Diameter Bomb program).[71] Air Force Internal priorities and resource constraints continue to suppress a promising enhancement to NBC/M mobile target capabilities.

Notes

[1] "Remarks by Honorable Les Aspin, Secretary of Defense, National Academy of Sciences, Committee on International Security an Arms Control," December 7, 1993, on-line, internet, 19 March 1993, available from http://www.chinfo.navy.mil/navpalib/policy/aspi1207.txt.

Notes

[2] An ACTD is a teaming operation between military operators and the development community (service or agency), under the sponsorship of a Unified Commander, to evaluate solutions to critical military needs that can be addressed using mature or emerging technologies. An ACTD typically lasts two to four years (although some have been shorter) and generates a limited operational capability for the warfighter that could enter the formal acquisition process (Predator UAV is an example of such an ACTD). The majority of the funding for an ACTD comes from the executing service or agency acquisition activities and all ACTDs are approved/prioritized by the Joint Requirements Oversight Council. For a brief description of the ACTD process, see U.S. Cong., Senate, Armed Forces Committee, Strategic Forces Subcommittee, "General Richard B. Myers' Written Testimony Presented to the Senate Armed Services Committee Strategic Forces Subcommittee," March 22, 1999, on-line, internet, available from http://www.fas.org/ spp/military/congress/1999/990322-speech14.htm.

The two NBC/M counterforce-related ACTDs—Counterproliferation (CP) 1 and 2—"deliverables" included sensors, tools, and weapons. CP1 ACTD deliverables were the Lantirn Bomb Damage Impact Assessment Modification; Munitions Effectiveness Assessment (MEA) and the Hazard Prediction and Assessment Capability (HPAC) modules for the Integrated Munitions Effectiveness Assessment (IMEA); and the Hard Target Smart Fuse and Advanced Unitary Penetrator. CP2 deliverables will include the WMD Combat Assessment System; IMEA and the Integrated Target Planning Tool Set (ITPTS); and Convention Air-Launched Cruise Missile (CALCM) Penetrator Variant, and Tactical Tomahawk Penetrator Variant. Discussion of these deliverables follows in the text. Information that follows on CP-1 and CP-2 in the text provided during discussions with DTRA officials.

[3] Current plans are for CAPS to address 45 NBC/M programs in 16 countries. The top 18 programs have already been completed to the key facility level. Another tool under development that supports target planning for NBC/M targets is "ATHENA"—a counterproliferation intelligence, on-line, "information space" that contains available counterproliferation references, intelligence information, and analytical tools, and provides analysts a digital working environment in which to share documents and work. See "Selected Accomplishments in DoD Counterproliferation Programs" in CPCR *Executive Summary*, p. ES-8. CAPS and ATHENA priorities are identified and coordinated by the Counterproliferation—Mission Support Senior Oversight Group (CP-MS SOG), its Standing Committee, and its four Subcommittees (Requirements; Intelligence Production; Planning Tools; and Connectivity, Release, Dissemination). While this paper will not discuss Counterproliferation organizations and their roles, the CP-MS SOG warrants mention here, since due to its relatively recent establishment, it is unlikely to receive mention in other discussions. On Counterproliferation organizations and their roles (less CP-MS SOG), see Schneider, *Future War and Counterproliferation*, pp. 45-61. On CP-MS SOG, see U.S. Department of Defense, Office of the Secretary of Defense, Deputy to the Assistant Secretary of Defense (Counterproliferation and Chemical/Biological Defense), "Counterproliferation—Mission Support Senior Oversight Group Charter," 16 Sep 1999.

Notes

[4] U.S. Cong., Senate, Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, "Statement of C. Bruce Tarter, Director University of California Lawrence Livermore National Laboratory," on-line, internet, Sept. 27 2000, available from http://www.fas.org/spp/starwars/congress/ 1997_h/h970410t.htm.

[5] On CAPS, also see Chandler, "Locating and Destroying." Chandler indicates that CAPS also contains information on defenses, geography and facility accessibility.

[6] To be precise, MEA actual produces a damage expectancy: a probability of achieving a specified type and level of damage against a target with specified munitions.

[7] MEA is the only existing tool for tunnel weaponeering. MEA generates two- and three-dimensional models of tunnel segments, portals, geology, and equipment contained in facility for support (utilities, blast doors) or for safeguarding (missiles, TELs). On MEA, see also Clifford Beal, Mark Hewish, and Leland Ness, "Hard Target Attack: Forging a Better Hammer," *Jane's International Defense Review*, vol. 29, no. 7 (July 1996), p. 33.

[8] HPAC software is available from DTRA by license for research. See the DTRA HPAC web page for information and a brief overview of HPAC: http://www.dtra.mil/ td/hpac/td_hpac.html.

[9] Beal, pp. 32-37 and "The Threats Go Deep." *Air Force Magazine*, vol. 80, no. 10 (Oct. 1997), pp. 47-49.

[10] See Beal and Lisa Burgess, "Iraq Faces Much-Improved U.S. Airstrike Arsenal," *Defense News*, vol. 13, no. 7 (Feb. 16-22, 1998), p. 14.

[11] Burgess.

[12] The Air Force specially designed and constructed the Guided Bomb Unit-28 (GBU-28) "Bunker Buster" during the Gulf War from Army artillery tubes, to attack hardened Iraqi command centers located underground. The GBU-28 is a 5,000lb class, 19ft long, laser-guided conventional munition with a 4,400lb penetrating warhead. The F-111, which has since been retired from service, delivered the GBU-28 during Operation DESERT STORM. During Operation ALLIED FORCE/NOBLE ANVIL, the F-15E was used to deliver the GBU-28 to attack deeply buried targets. The GPS aided munition GBU-37 provides a similar capability, but with reduced accuracy. The B-2 is the GBU-37's exclusive delivery vehicle.

[13] Why the Air Force has not fielded AUP remains an open research question. Also intriguing are statements that would indicate that AUP saw service during Operation ALLIED FORCE, although the author has been unable to confirm this. For example, according to Joseph J. Eash III, the Deputy Secretary of Defense for Advanced Concepts and Systems, AUP was called into service for Operation ALLIED FORCE: "As alliance strikes became more effective, Yugoslav mil hardware was often hidden in caves, tunnels, and hardened facilities required penetrating munitions… in anticipation of this the theater requested the 'Advanced Unitary Penetrator.' It has twice the penetration capability of previous hard-target munitions and is capable of counting layers and voids in structures, calculating distances traveled and detonating at a predetermined depth." Joseph J. Eash, III, "Harnessing Technology for Coalition Warfare," *NATO Review*, vol.

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28 no. 2 (Summer/Autumn 2000), pp. 32-34, on-line, internet, October 2, 2000, available from http://www.nato.int/docu/review/2000/0002-11.htm.

[14] The Air Force will take delivery of 50 CALCM penetrator variants (AGM-86D) beginning in February 2002. The Tactical Tomahawk is a new variant of the Navy's Tomahawk Land Attack Missile with an in-flight retargeting capability, a target identification capability, and a loiter capability (see discussion in Chapter 5). The first deliveries of the Tactical Tomahawk had been scheduled for 2003, but it appears that delivery will slip April 2004. The Navy plans to purchase 1353 Tactical Tomahawks. See "Boeing Delivers Improved Conventional Air-Launched Cruise Missile to the U.S. Air Force," *Boeing News Release*, January 11, 2001, on-line, internet, March 27, 2001, available from http://www.boeing.com/defense-space/missiles/calcm/calcm.htm; and Robert Holzer, "Delays Likely For Upgraded Tomahawk Missile," *Defense News*, February 26, 2001, p. 3, online, internet, February 26, 2001, available from http://ebird.dtic.mil/Feb2001/s20010226delays.htm. The JASSM is a long-range (370km), conventionally armed (blast-fragmentation warhead) missile that was developed for use against command and control type targets. The Air Force recently increased the number of JASSMs it intends to buy from 2400 to 3700 and will purchase 95 JASSMs in FY2002. On JASSM, see Craig Hoyle, "USAF to Boost JASSM Purchase," *Jane's Defense Weekly*, vol. 34, no. 19 (Nov. 8, 2000), p. 8.

[15] The Lockheed-Martin Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) targeting pod is used by the Air Force's F-15E and F-16C/D and the Navy's F-14 aircraft (NATO and other allied air forces use LANTIRN as well). On the F-15 and F-16 aircraft it is used in conjunction with the LANTIRN navigation pod, which provides for day/night, all weather, terrain-following navigation at high-speeds. The LANTIRN targeting pod is also used to provide more accurate delivery of the imaging infrared Maverick missile and unguided weapons. For background on LANTIRN, see the Lockheed Martin website (http://www.lockheedmartin.com/factsheets/product195.html); the FAS website (http://www.fas.org/man/dod-101/sys/smart/lantirn.htm); and the Air Force on-line LANTIRN fact sheet (http://www.af.mil/news/factsheets/LANTIRN.html).

[16] "Lantirn Pod Upgrade Aimed At Boosting Post-Strike Intel," *Aviation Week and Space Technology*, June 28, 1999, pp. 32-36, on-line, internet, March 28, 2001, available from http://www.aeronautics.ru/nws001/awst011.htm and "F-15, F-16 LANTIRN," *Journal of Aerospace and Defense Industry News*, May 16, 2000, on-line, internet, March 28, 2001, available from http://www.aerotechnews.com/starc/2000/051600/Contract_Briefs.html. To further enhance assessment capabilities, DTRA also plans to develop a post-strike chemical assessment system (Chemical Combat Assessment System), as part of the second ACTD. This system will employ: a remote sensor (PIRANHA) on the Predator UAV to detect, identify, track, and characterize chemical agent clouds from a standoff distance; and two mini-UAVs released from Predator for sample collection (subsequent recovery by SOF). DTRA plans to deliver four Chemical Combat Assessment Systems by late 2003.

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[17] Tarhunah was vulnerable with the B-53 weapon, but only the B-52 could carry this weapon, and not the B-2. Jeff Erlich, "Bunker-Busting Bomb Prompts U.S. Discord," *Defense News*, vol. 12, no. 8 (Feb. 23 - Mar. 2 1997), p. 1. See also, Beal.

[18] Stephen M. Younger, "Nuclear Weapons in the Twenty-First Century," June 27, 2000, on-line, internet, Oct. 24, 2000, available from http://www.fas.org/nuke/guide/usa/doctrine/doe/index.html.

[19] Comments of Dr. Jay Davis, Director of DTRA. Andrew Koch, "Dual Delivery is the Key to Buried Targets," *Jane's Defense Weekly*, vol. 33, no. 10 (March 8, 2000), p. 11. Similarly an "unnamed army official:" "Today, there are thousands of hard and deeply buried targets in countries such as Libya, Syria, and North Korea." See George I. Seffers, "ATACMS Gets Mission To Be Bunker Buster," *Defense News*, vol. 12, no. 40 (Oct. 6-12, 1997), p. 1.

[20] These developments have been highlighted in the press as well: see Walter Pincus, "Buried Missile Labs Foil U.S. Satellites: N Korea, Iran Among "Intelligence Gaps," *Washington Post*, July 29, 1998, p. 1, online, internet, September 18, 2000, available from http:/intellit.muskingum.edu/intellsit…stwar90s_folder/postwar90srumsfeld.html.

[21] The Defense Department has constructed its own series of tunnels that replicate potential facilities and proved targets against which weapons can be tested (Tunnel Defeat Demonstration Program). See Koch and Starr.

[22] Koch, "Dual Delivery." Other means of functional defeat are also being examined to include attacking/disabling support elements (water, power, communications), life-support systems (ventilation), or the mission equipment located in the facility. Information Operations is an avenue also being explored. Regarding NBC/M facilities, it is not clear that any of these other means (except for SOF breeching and entry to destroy mission equipment) could inflict more lasting damage. As emphasized by George W. Ulrich, the former Deputy Director of DSWA, "The conventional solution has got to focus on functional defeat mechanisms…. experimental concepts have been explored. Even with those it's an incremental gain. You can always find a mountain that is going to go a lot deeper than the weapon." "The Threats Go Deep," p. 49.

Using unclassified sources, it is impossible to determine what percentage of the NBC/M deep underground facilities are simple (single) tunnels—with one or two portals designed for concealment and protection of assets such as missile launchers and related equipment—and what percentage are complex facilities—with miles of tunnels and numerous portals, designed for production activities or long-term storage. Arguably, simple tunnels likely constitute the majority of the deep underground facilities for the following reasons. Complex tunnel facilities require a tremendous commitment of resources and the signature produced by their excavation is more likely to compromise a facility's existence (although not precise tunnel locations) than the excavation of a simple tunnel. Informed commentators point to the enormous facilities that could be constructed rapidly using mechanical excavation techniques—tunnel boring machines (also know as "TBMs"). However, despite their efficiency, TBMs are expensive to purchase (up to $100 million), their purchase and use would be difficult to conceal prior to the progress

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of the TBM underground (TBMs can weigh over 95 tons). Depending on the TBM and geology, foreign technical assistance would likely be required for at least maintenance of the machine and replacement of cutters. Complex facilities could also be excavated through traditional drill and blast—a more time consuming and sequential operation consisting of cycles for drilling, explosives loading, blasting, ventilating, and muck removal. Depending on the size of the underground operation and type of drilling rigs (large rigs could be rail mounted; sophisticated multiple-boom rigs could be fully computerized), an obvious notable surface signature is also likely.

This paper will not go into the tremendous difficulties of precisely locating tunnels. On locating tunnels, see Eric M. Sepp, "Deeply Buried Facilities: Implications for Military Operations," Occasional Paper No. 14 (Maxwell AFB, AL: Center for Strategy and Technology, Air War College, May 2000); on promising new techniques for locating tunnels, see Anestis J. Romaides, et al., "A Comparison of Gravimetric Techniques for Measuring Subsurface Void Signals," *Journal of Physics D: Applied Physics*, vol. 34, no. 7 (February 7, 2001), pp. 433-443.

[23] To kill biological agents or neutralize/breakdown chemical agents, a heat spike of 2000 degrees is required for a time period of one to two minutes. These conditions can't be achieved with a single bomb. Multiple bomb solutions and the use of rocket motors as an incendiary bomb have proven impractical. Adam J. Herbert, "Defense Agencies Evaluating New Ways To Defeat Chem-Bio Threats," *Inside the Air Force*, November 30, 2000, p1; Robert Wall and David A. Fulghum, "Destroying Chem/Bio Sites Confounds Weapon Makers," *Aviation Week and Space Technology*, vol. 153, no. 13 (Sep. 25, 2000), p. 79; and John J. Lumpkin, "KAFB Battles Chemical, Germ Warfare," *ABQJournal.Com*, August 11, 1999, p. A1.

[24] Thomas E. Ricks, "U.S. Military Considers Weapons That Disable Bunkers, Spare People," *The Wall Street Journal*, July 1, 1999, p. 1. Ricks (also Wall and Fulghum, "Destroying Chem/Bio") mentions the use of flechettes to puncture containers and spill agents out within the facility. While not a perfect solution, this concept could offer an improvement over high explosives that expel the agent from the facility. This is an example of an incremental solution that should be pursued (see Chapter 6 discussion).

[25] Joint Pub 1-02. Definition does not explicitly include threats to civilian populations.

[26] The window of vulnerability for mobile missiles is generally considered to be the period when it emerges from hiding to prepare for, conduct, and recover from a missile launch. For a liquid fueled missile such as a Scud approximate timelines for these activities are: 30-45 minutes for launch preparation and launch; 3-5 minutes for recovery ("pack and run"). For more modern solid fueled mobile missiles and ground launched cruise missiles, launch preparation and launch would likely require only 15 minutes. During the Persian Gulf War, Iraqis demonstrated that they could set up a Scud missile for launch in 45 minutes, fire the missile in 2 minutes, stow the firing rail and be on the road within 5 minutes, and get the TEL out of detection range or hidden in another 10-15 minutes. As for the hiding period before launch, Soviet technical manuals indicate that a Scud can remain fueled for as long as sixty days. On Scud timelines, see discussion in

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David A. Fulghum, "Cobra Ball Revamped for Battlefield Missions," *Aviation Week and Space Technology*, vol. 147, no. 5 (Aug. 4, 1997), pp. 48-50 and McCarthy and Tucker, pp. 70-74.

If we estimate 15 minutes for a standoff weapon to fly out and strike the TEL, this leaves only 30 minutes during launch preparation to detect, identify, allocate a weapon and attack the target. For solid fueled missiles and cruise missiles the time challenge is even greater. This is why a more comprehensive approach to the mobile missile challenge must be pursued further: expanding the window of vulnerability to periods when the TEL is traveling to and from hide sites (moving targets); and attacking support equipment and potential hide sites to disrupt timelines/launch schedules—focusing on the destruction of launches over a period of time.

[27] On the subject of Global Hawk replacing versus supplementing the manned U-2 reconnaissance aircraft, see Amy Butler, "Peters Accelerates Global Hawk Sensor Development, Block 10 Buys," *Inside The Air Force*, September 29, 2000, p. 1, on-line, internet, September 29, 2000, available from http://ebird.dtic.mil/Sep2000/ s20000929peters.htm. Global Hawk is not a stealthy UAV and like the U-2: likely will require fighter escorts on some missions (like U-2 overflights of Iraq) and is vulnerable to high altitude surface-to-air missiles (the two are "approximately" equally survivable and neither are "expendable" assets). Global Hawk is not designed to carry the signals intelligence sensors (SIGINT) that the U-2 carries and will not have as powerful a synthetic aperture radar (SAR) capability. However, it takes five U-2s to provide 24-hour coverage, but only two Global Hawks, since Global Hawk has twice the range and three times the endurance (24 hours on station) of the U-2. See also Richard A. Best and Christopher Bolkcom, "Airborne Intelligence, Surveillance & Reconnaissance (ISR): The U-2 Aircraft and Global Hawk UAV Programs" (Washington, D.C.: Congressional Research Service, Nov. 6, 2000); and Bill Sweetman, "HALE Storms To New Heights," *Jane's International Defense Review*, March 2001, p. 50, on-line, internet, March 8, 2001, available from http://ebird.dtic.mil/Mar2001/s20010308hale.htm.

[28] JSTARS provides two basic capabilities: ground surveillance and battle management. JSTARS provides ground surveillance through its radar, which provides Moving Target Indicator (MTI) data and Synthetic Aperture Radar (SAR) imagery. The JSTARS radar has a coverage of nearly 50,000 sq km at distances of 50-250km from the aircraft. Current JSTARS SAR resolution is not sufficient for providing target classification (tank vs. tractor vs. truck vs. TEL) or identification (TEL type). JSTARS provides battle management (real time command and control) through its extensive voice and data communications links, leveraging the data it has obtained through surveillance. It provides procedural control for incoming strike aircraft, cueing for target identification, threat warning, and attack support and receives in-flight reporting from outgoing aircraft. See the discussion of JSTARS in Chapter 6, as well.

[29] A synthetic aperture radar (SAR)—such as the sensor on the U-2—provides day or night, all-weather, photographic-like images/maps of selected geographic regions that can be used to precisely locate and identify stationary objects/targets. Ground moving target indicator (GMTI) provides wide area surveillance and is used to detect and track moving

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targets (predominantly on the ground). Through the use of GMTI in a high-resolution mode (small geographical area) and through advanced signal processing, moving targets can be classified (truck, tank, TEL) and identified (specific type of TEL—MAZ-543). A single radar, such as the existing Joint Surveillance Target Attack Radar System (JSTARS), the existing sensor on and the Global Hawk ACTD can function (essentially) in either of these two modes, SAR mode or GMTI mode, but not simultaneously. See the discussion that follows in the text and in Chapter 6.

[30] Originally, the Radar Technology Insertion Program (RTIP) was a Pre-planned Product Improvement for the Joint Surveillance Target Attack Radar System (JSTARS). RTIP would replace the existing side looking phased array radar on JSTARS with a two-dimensional active electronically scanned array (2-D AESA) radar. With respect to mobile missile detection/identification, the benefits would have included improved automatic tracking, improved SAR resolution for target classification and identification, and interleaving of GMTI and SAR modes to permit uninterrupted surveillance of the ground coverage area while imaging high priority targets. Although the Defense Acquisition Board approved Engineering and Manufacturing Development of RTIP in January 2000, the Air Force decided to explore alternate paths (non-Boeing 707 airframe) to delivering the Wide Area Surveillance (WAS) capability that JSATRS RTIP would have provided to the warfighter. The Air Force restructured the JSTARS RTIP program into Multi-Platform RTIP program to explore modular, scalable 2-D AESA radars for potential integration into multiple platforms. MP-RTIP production plans include radars for five manned platforms and 40 Global Hawk UAVs (and the possible procurement of six radars for NATO Air Ground Surveillance (AGS) programs). The Air Force will not make a decision as to which manned platform will house the 2-D AESA radar until FY2002. Background information on JSTARS was obtained through discussions with SAF/AQ officials.

[31] Steel Rattler is reported to have an acoustic range (depending on the weather and terrain conditions) of 50 to 2000m; a target identification range of 500m; and unit price of $60K. See Lum, Zachary, "The Measure of MASINT," *Journal of Electronic Defense,* August 1, 1998, p. 43. While the U.S. has years of experience with unattended ground sensors (UGS) in Vietnam and with the U.S. Sinai Support Mission (since 1976), "advances in digital signal processing (DSP) have spawned faster yet smaller and lower power computer chips that provide an opportunity for executing computationally extensive algorithms in real time. These advances have made the develop of practical UGS [unattended ground sensors] possible." Practical limits on UGS include weather and knowledge of the terrain. On UGS development, see Nino Srour, "Unattended Ground Sensors: A Prospective for Operational Needs and Requirements," October 1999, Army Research Lab Sensors and Electronic Devices Directorate, on-line, internet, January 16, 2001, available from http://info.arl.army.mil/acoustics/nsrour.htm.

[32] ARGUS—formerly know as "Steel Eagle" during ROVING SANDS 2000—could be delivered by the F-15E (and potentially by the F-22) from altitudes exceeding 15000ft. Mark Hewish, "U.S. Air-deliverable TBM Detector Set For Deployment," *Jane's International Defense Review*, vol. 33, no. 5 (May 2000), p. 12.

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[33] These sensors, conceivably, also could be used in conjunction with remote munitions such as the Army's Wide Area Munition (WAM), which will enter low rate initial production in 2003. WAM apparently also has acoustic and seismic sensors and an acoustic signal processor. WAM has a detection radius of 650m and a lethal radius of 100m. It has a skeet munition with an infrared sensor that detects and tracks the target, hovers over the target and fires an explosively formed projectile. Although WAM is currently emplaced by hand, the Army is looking at a rocket, aircraft, and helicopter delivered version. The Army has also demonstrated a capability to deliver, recover, and redeploy WAM by UAV (CAMCOPTER UAV system). Frank Tiboni, "U.S. Army Fields New Precision-Guided Munition," *Defense News*, vol. 16, no. 4 (January 29, 2001), p. 6.

[34] Link 16 improves the effectiveness of platforms conducting a variety of air-to-air and strike missions, by providing positive position awareness of all aircraft on the network, display of off-board sensor data and real-time sharing of target, threat, and intelligence information. For a DoD-wide overview of Link 16, see FAS website: http://www.fas.org/man/dod-101/sys/land/htm. On current USAF Link 16 efforts, see: U.S. Department of the Air Force, Headquarters USAF, "Link 16 Acceleration," General John P. Jumper, Commander, ACC, September 25, 2000; and U.S. Department of the Air Force, Headquarters USAF/XOCE, "Link-16 Task Force," Briefing, November 16, 2000.

[35] With regards to other platforms, as part of the JSTARS Attack Support Upgrade (ASU; see discussion in Chapter 6), JSTARS would receive the Improved Data Modem (IDM)—a less capable, yet less expensive, direct targeting support data link to: the US Army's Army Aviation Command and Control System (A2C2S); Apache Longbow attack helicopters; and to the older F-16s (Block 40) that are flown by the U.S. Air Force and NATO allies.

[36] William G. Chapman, "Organizational Concepts for the Sensor-to-Shooter World: The Impact of Real Time Information on Airpower Targeting" (Maxwell AFB, AL: School of Advanced Airpower Studies, Air University, May 1997), p. 42.

[37] Background information on Link 16 also obtained through discussions officials in AF/XOR, AF/XOC, and AF/AQI.

[38] The Air Force uses the JEFX series to explore new operational concepts and technologies. The yearly experiment combines live-fly and simulation to rapidly evolve and mature specific warfighting capabilities and command and control processes. The ROVING SANDS series of Joint exercises provides an environment for both simulation and live Air/Missile Defense and Attack Operations training. Similarly, NATO uses the Dutch national exercise OPTIC WINDMILL (in which U.S. European Command participates) to test TMD tactics, procedures, and architectures, and to familiarize participants with U.S. and NATO TMD concepts and programs.

[39] William B. Scott, "Experimental Center Nails Time-Critical Targets," *Aviation Week and Space Technology*, vol. 153, no. 14 (Oct. 2, 2000), p. 71.

[40] Frank Wolfe, "Air Force Hopes to Reduce Time Critical Targeting to Minutes," *Defense Daily*, vol. 207, no. 48 (September 8, 2000), n.p.

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[41] Link 16 integration costs for the bomber fleet (approximately \$600-\$700 million each for B-2 and B-1) are much higher than fighter integration costs (approximately \$400 million each for F-15 and F-16), due to in part the requirement for a beyond line-of-sight communications capability. See also Kerry Gildea, "Air Force Experiment Validates Link 16 Performance," *Defense Daily*, n.d., n.p.

[42] See Chapter 6 for a further discussion of Link 16 issues.

[43] See Scott, pp.70-72.

[44] The second path moves TCT into the realm of "dynamic battle control"—the real-time sharing and control of BM/ISR and strike assets. Col. Mark Lindsey, the TCT director for JEFX 2000 had the following final assessment of the TCT results: "The concept and process are ready for fielding. The systems are another issue. There are definitely some systems here that are mature, and some that are not…. How we did it here is probably not exactly the way the Air Force will decide to do time-critical targeting—but we've made some real progress." Scott, p. 72. Even within the Air Force, a variety of views exist on TCT Cell development, to include dispensing with the cell concept altogether but training individuals in the Air Operations Center to perform its functions.

[45] Using visual bombing techniques, unguided weapons (general purpose bombs, area denial munitions) could be used to defeat mobile targets. Shorter-range weapons compose the vast majority of the GPS-guided/precision-guided munitions inventory, they include: laser-guided bombs, TV/laser-guided Maverick missiles, JDAM, JSOW, SFW; medium range systems include: SLAM and SLAM-ER (AGM 84E/F), AGM-130, AGM 142 HAVE NAP, and the JASSM (2002). Longer- range systems include the CALCM and TLAM (Tactical Tomahawk in 2003). The current weapon of choice for mobile missile attack would likely be the GBU-12 (Paveway II) laser guided bomb that can be carried by the F-15E as well as a number of other platforms. Longer-range systems would be preferable in high-threat air defense environments (such as those that will likely characterize anti-access scenarios). For weapons information, see the FAS website (http://www.fas.org/man/index.html) and U.S. General Accounting Office, *Weapons Acquisition: Guided Weapons Plans Need to be Reassessed*, GAO/NSIAD-99-32, (Washington, D.C.: GAO, December 1998).

[46] The Army also originally planned to field the BAT P^3I submunition on the ATACMS Block IIA missile, but reallocated funding for the Block IIA missile to other programs. The Block IIA missile would have delivered 6 BAT submunitions to a range of 300km. Glenn W. Goodman, Jr., "Nowhere to Hide: New Smart Munitions Rain Certain Destruction From the Sky," *Armed Forces Journal International*, vol. 135, no. 3 (Oct. 1997), pp. 58-64; see also, http://www.fas.org/man/dod-101/sys/land/atacms-bat.htm.

[47] Tactical Tomahawk upgrades would add the capability to reprogram the TLAM while in-flight to strike any of 15 preprogrammed alternate targets or to redirect the missile to any Global Positioning System (GPS) target coordinates (a new target). Tactical Tomahawk also would be able to loiter over a target area for some hours. Tactical Tomahawk would permit mission planning aboard cruisers, destroyers and attack

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submarines for quick reaction GPS missions. CP-2 ACTD is modifying Tactical Tomahawk (Penetrator Variant) to incorporate the penetrator warhead and the hard-target smart fuse (see Chapter 4; expected to be completed by March 2003). See U.S. Department of the Navy, Chief of Naval Operations, "Tactical Tomahawk," Briefing, January 5, 2000.

A typical carrier battlegroup could have over 400-500 vertical launch cells for firing the Tomahawk (plus torpedo tube capacity) and, hence, the Tactical Tomahawk (currently designed for vertical launch cell launch only). However, Tomahawk must compete with other systems for space such as the Standard SAM on Ticonderoga and Arliegh Burke-class cruisers and destroyers and Anti-Submarine Rocket (ASROC) aboard Spruance class destroyers (the primary Tomahawk shooters). Thus, the battlegroup likely has 200-250 Tomahawks available for launch (underway replenishment of Tomahawks is not practical due to missile canister size/ weight and crane requirements). In the future, Tomahawk will also have to compete for cell space with theater missile defense interceptors used in Navy Area and NTW. On Navy issues relating to attack operations and active TMD, see Charles C. Swicker, "Theater Ballistic Missile Defense from the Sea: Issues for the Maritime Component Commander," Newport Paper Number Fourteen, Naval War College, on-line, internet, March 28, 2001, available from http://www.nwc.navy.mil/press/npapers/np14/np14toc.htm.

[48] At $569K, the price is also an improvement over the Block III TLAM's price, which could be as low as $750K and as high as $1.4 million (new). Nonetheless, at $569 a copy, it would be quite unlikely that a commander would launch a Tactical Tomahawk without a preplanned target, in expectation of finding a mobile target. Moreover, a commander would want to be highly confident that the mobile missile target would still be there when the Tactical Tomahawk arrives on target coordinates, to expend such a precious resource. Press reporting indicates that the Tactical Tomahawk program now faces a six-month delay that may slip delivery to 2004 (date of information: April 2001).

[49] This time reduction is not only a function of the proximity of a loitering missile to the target, but a reduction in planning time as well. The Navy seeks to reduce the planning time to below 5 minutes, from the 30-60 minutes the Tomahawk Block III missile requires for time critical (afloat planned) missions, using the new Tactical Tomahawk Weapon Control System's Rapid Planning Module. Planning for (ashore) pre-planned Tomahawk missions, which would provide for more careful and detailed routing of the missile (*i.e*, lower risk) can take 8-9 hours or longer. See "Tactical Tomahawk Passes Test," *APL Update*, June 15, 2000, Applied Physics Laboratory, The John Hopkins University; U.S. Department of the Navy, Naval Warfare Development Command, "FBE G NWDC Briefing," n.d., on-line, internet, February 8, 2001, available from http://www.nwdc.navy.mil/Products/FBE/golf/FBE_G.html; and U.S. Department of the Navy, "Tactical Tomahawk.."

[50] The official unclassified range of LASM is "in excess of 100nm." An approximate calculation of LASM time of flight, using the unclassified speed of the Standard Missile (Mach 2), indicates a time of 9 minutes out to a range of 200nm. LASM per unit cost is $275 (FY1997 dollars). On ERGM (and LASM) employment, see

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"Concept of Employment for Naval Surface Fire Support (Near Term Capability)," on-line, internet, February 1, 2001, available from http://www.fas.org/man/dod-101/sys/ship/weaps/docs/C1031.htm#Top.

[51] For comparison purposes, a Tactical Tomahawk, which would likely travel at 360kts, would require approximately 25 minutes to cover a 250nm distance.

[52] Information on Navy weapon systems can be found at: "Vision, Presence, Power: A Program Guide to the U.S. Navy," 2000 Edition (available from http://www.chinfo.navy.mil/navpalib/policy/vision/vis00/top-v00.html). On LASM, see also http://www.fas.org/man/dod-101/sys/missile/lasm.htm.

[53] Design to unit production cost of LOCAAS is $33K (FY1998, based upon a 12000 buy; according to Lockheed Martin, the cost to the Air Force would likely be around $50K). For LOCAAS information, see U.S. Department of the Air Force, Air Force Research Lab Munitions Directorate, "Industry Day LOCAAS Brief," June 24, 1998, on-line, internet, January 31, 2001, available from http://sun00781.dn.net/man/dod01/sys/smart/docs/locaas_Industry_Day/index.htm; and David A. Fulghum and Robert Wall. "Mini-Bombs Dominate U.S. Weapons Plans," *Aviation Week and Space Technology*, vol. 153, no. 13 (Sep. 25, 2000), p. 86.

[54] LOCAAS search capabilities are 2.6 sq. nm/min at 200 knots and at a 750 ft search altitude for 33 sq. nm search area. LOCAAS searches for its top (preprogrammed) priority target first, if it does not find its top priority target, it will attempt to relocate a lower priority target that it had previously identified. See Air Force Research Lab.

[55] Air Force Research Lab and Fulghum, "Mini-Bombs."

[56] The Areas for Capability Enhancements (ACEs) "define those priority areas where additional capabilities are needed to meet the challenges posed by the proliferation of NBC weapons and their means of delivery (NBC/M), including those posed by paramilitary and terrorist NBC threats." The ACEs are "reviewed annually to ensure that they continue to reflect the warfighting needs of the CINCs [Commanders-in-Chief]" and the "evolving needs and shortfalls that change as threats evolve and become better understood and as research and development (R&D) and acquisition (RD&A) programs mature, enabling new operational capabilities." See Counterproliferation Program Review Committee, *Report*, (2000), pp. ES-2 and ES-3.

[57] "Prompt mobile target detection and defeat" is also ranked 11th out of eleven U.S. Intelligence priorities for Counterproliferation.

[58] Compiled from Executive Summaries from 1994-2000. See Counterproliferation Program Review Committee, *Report*, (2000); All reports are available from the Committee's website: http://www.acq.osd.mil/cp/reports.html.

[59] "While higher priority ACEs generally receive greater investment, the distribution shows some variability due to a variety of factors including the fact that some ACEs simply require greater investment than others (*eg* those requiring more extensive R&D) to reach fruition…it is difficult to judge by looking at the budget numbers alone…[some] programs relate to several ACEs." This explains why ballistic missile and cruise defense (priority 5) gets six times the funding than the total funding of priorities one through four. See also, Counterproliferation Program Review Committee, *Report*, (2000), p. ES-3.

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[60] See Appendix A for a complete listing of areas with funding percentages. Over the term of the Counterproliferation Initiative, the funding situation of counterforce relative to active missile defense has deteriorated. For example, for 1996, 63% of the entire DOD counterproliferation investment was devoted to research and development of active missile defenses; "programs focused on counterforce operations against mobile missiles in particular were funded at less than 8 percent of the level for active missile defenses." Dennis M. Gormley and K. Scott McMahon, "Counterforce: the Neglected Pillar of Theater Missile Defense," Centre for Defence and International Studies, Lancaster University, on-line, internet, September 19, 2000, available from http://www.cdiss.org/colsep1.htm.

[61] A search of the unclassified programs did reveal two other programs supporting the mobile area under active defense: Air Force Theater Missile Defense R&D Program ("R&D integration to improve BM/C4I and attack operations capabilities and their supporting elements" ($20 million)); and Air Force Space Based Infrared System ($908 million). It would seem that these programs do contribute to mobile missile defeat, but the primary beneficiary is still active defense.

[62] CPRC 1994 Report *Executive Summary*, Figure 1; see http://www.acq.osd.mil/cp/reports.html.

[63] In reflecting on the past eight years of the Counterproliferation Initiative, Henry Sokolski, notes: "Unable to secure large sums for a new, separate counterproliferation mission, Defense Department officials began arguing that nearly the entire defense budget was targeted against the threat of proliferation." See Sokolski.

[64] See for example Secretary Aspin's comments founding the Counterproliferation Initiative in "Remarks by Honorable Les Aspin, Secretary of Defense, National Academy of Sciences."

[65] Jerome H. Kahan, "Nuclear Threats from Small States" (Carlisle, PA: Strategic Studies Institute, Army War College, June 13, 1994).

[66] See "Naval Fire Support."

[67] See "Naval Fire Support."

[68] Industry reporting indicates that Raytheon is looking at new warhead for LASM in order to defeat mobile targets—precisely because mobile targets are something that ERGM, LASSM, and Tomahawk "cannot do." See Kerry Gildea, "Raytheon Maps Future Upgrades for LASM," *Defense Daily*, vol. 209, no. 20 (January 31, 2001), n.p. If ERGM and/or LASM are equipped with a capability to receive in-flight target coordinates updates (at a sufficiently high update rate) and a target spotting/data-link system is fielded to provide these updates, ERGM and LASM could provide a mobile target capability. An independent seeker on the munition—that which LOCAAS possesses and which the LASM nose cone could easily accommodate—is not absolutely necessary, and in some circumstances the target spotting/data-link system could perform the seeker's function.

[69] A frequent complaint is that the Air Force has historically underfunded weapons development and in recent years maintained its weapons funding at a static level despite the growing needs *(e.g.*, urban operations, directed energy and non-lethal weapons). For

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a history and overview of the LOCAAS program see Air Force Research Lab. Munitions Directorate, "Industry Day LOCAAS Brief."

[70] Perhaps the greatest setback to the LOCAAS program was the U.S. Air Force decision in May of 1997 not to submit LOCAAS as an Advanced Concept Technology Demonstration (ACTD). The Air Force was apparently concerned about the "perceived" level of LADAR/ATR maturity and thought that the concept definition needed further refinement; nor would the Army provide funding. Even if the Air Force had valid concerns about "perceived" level of LADAR/ATR in 1997, such concerns should be have been dispelled by today. As part of the $85M Net Fires Program, DARPA is using work done with the LOCAAS LADAR seeker and ATR to develop technologies for two new missiles: the Precision Attack Missile and the Loitering Attack Missile. The ACTD route would have been an effective means to rapidly field a mobile missile munition. Andrew Koch, "DARPA Works on Missiles for Possible Use on FCS," *Jane's Defense Weekly*, vol. 34, no. 12 (September 20, 2000), p. 12.

[71] In January 1998 U.S. Air Force Air Combat Command—which overseas the fighter and bomber weapons developments process—combined LOCAAS and the Small Bomb System (SBS—also known as the small smart bomb or SSB) programs together into a single program called the Miniature Munition Capability (MMC), in effect signaling that funding was not adequate to pursue both programs simultaneously. Indications are that MMC will first proceed with the SBS—now known as the Small Diameter Bomb (SDB)—because of its effectiveness against a broader (fixed) target set (fixed C3 sites; radar sites; petroleum, oil, and lubricants (POL) sites; airfield type targets; industrial/infrastructure (electrical power); anti-aircraft artillery/SAM sites). SDB would likely be a 250lb, GPS-guided munition and have higher loadouts and, thus, lead to higher sortie effectiveness for internal carriage systems like the Joint Strike Fighter (JSF) and the F-22. The Air Force is looking for an SDB initial operational capability in 2007. After phase one (SDB), MMC would then address the mobile/relocatable target set. LOCAAS may or may not move forward at that time (a GPS guided glide version of SDB would likely also be a candidate). If LOCAAS were pursued during subsequent phases (phase two: limited area search and engagement of mobile targets; phase three: wide area search and engagement of mobile targets), it could lead to production by 2008-2009. See Christian Lowe, "Smaller Smart Bombs Move Closer to Reality," *Defense Week*, March 19, 2001, on-line, internet, March 20, 2001, available from http://ebird.dtic.mil./Mar2001/s20010320smaller.htm.

Chapter 6

Sharpening the Counterforce Sword: Near- to Mid-term Counterforce Capability Enhancements

> *There is no simple solution to the threat posed by the proliferation of weapons of mass destruction and their delivery systems…the right balance has to be struck.*[1]
>
> —U.S. Secretary of Defense William Cohen, 1997

The current NBC/M threat presents a central challenge to U.S. ability to project expeditionary military power, especially into regions such as the Middle East. Moreover, as emphasized in the Department of Defense's *Proliferation Threat and Response* and earlier in the Rumsfeld Commission Report, we can expect the NBC/M threat to grow in both numbers and technical sophistication in the near-to mid-term. Regrettably, the U.S. has neglected the development of NBC/M counterforce capabilities—capabilities that are essential for warfighting in an NBC/M environment behind an unfinished TMD active defense shield.

These circumstances notwithstanding, restructuring and relatively modest- to intermediate-sized investments in select mature programs could significantly enhance our NBC/M capabilities in the near- to mid-term. None of these select programs is a breakthrough technology or system that presents a comprehensive solution to the NBC/M challenge. They are comparatively limited—and with the exception of LOCAAS—

arguably incremental improvements, representative of a number of similar capability enhancement opportunities that existing priorities and processes have left unfunded or inadequately funded.[2] The following five recommendations should be immediately implemented: LOCAAS program acceleration; MP-RTIP acceleration; JSTARS radar and data-link upgrades; the installation of the Theater Airborne Warning System (TAWS) on the RC-135 RIVET JOINT fleet; and the establishment of an NBC/M counterforce planning and execution team.

A recommendation concerning the Agent Defeat Weapon, perhaps the most critical capability required for comprehensive NBC/M counterforce capabilities, does not appear on this list, for even with a substantial infusion of resources, it would not likely deliver a operational capability in the near-to mid-term. Nonetheless, a solution to agent defeat, or set of incremental solutions that meets less stringent collateral effects criteria, needs to be a high priority. This is unlikely to occur until there is broader recognition for NBC/M counterforce's unique requirements and more vigorous advocacy for them within the Services' and the Joint requirements processes.

Low Cost Autonomous Attack System (LOCAAS)

The first recommendation addresses the most serious deficiency in capabilities—mobile missile defeat, specifically the ability to destroy mobile missile TELs. LOCAAS clearly emerges as the leading candidate to fill this capabilities gap for three primary reasons. First, the majority of the other weapons would not address the mobile versus relocatable target set as effectively as LOCAAS. Other potential candidates—Tactical Tomahawk, LASM, and ERGM—as currently planned, would be effective against targets that have recently moved but are now stationary (relocatable targets), but would be much less effective in defeating moving targets.[3] Another possible candidate, BAT P^3I, would be less effective due to the range limitation of its delivery vehicle (ATACMS Block II missile) and its unpowered flight. Second, the LOCAAS munition is an extremely versatile solution. In addition to U.S. Air Force and Navy attack aircraft, a large variety of systems could deliver LOCAAS munitions, to include: attack helicopters, ATACMS, Multiple Launch Rocket System (MLRS), TLAM/Tactical Tomahawk, CALCM, JASSM, Predator UAV, and future UCAVs.[4] Third and most significant, LOCAAS is the only weapon with both a broad area target search capability and a warhead that would not require off-board target updates. These are essential features, in light of the continuing challenges associated with identifying TELs prior to missile launch and in light of the target location error associated with current sensors' missile launch detection capabilities. The approximate cost (research and development) of moving forward with the LOCAAS program is $300 million, although this cost would likely have been incurred as part of the Miniature Munitions Capability/Small Diameter Bomb Program in later years.

These features allow for the launch of a LOCAAS munition against a potential target without a visual identification of the target. LOCAAS provides a capability for mobile missile defeat in situations in which a pilot visually detects a missile launch but cannot locate or identify the TEL with current on-board systems before it is able to pack up and start to run.[5] As mentioned above, LOCAAS also provides a capability in situations in which a missile launch is detected by an off-board sensor, but a pilot cannot find the TEL as a result of target location error or subsequent movement of the TEL.

Additionally, LOCAAS could provide a proactive mobile missile targeting option, to conduct preemptive search and destroy or launch suppression missions. This may be difficult to imagine today—after the recent air war over Serbia in which no weapon was released without a visual identification accomplished by flying to the target—but it was also not so long ago that the U.S. Air Force balked at any preemptive High Speed Anti-Radiation Missile (HARM) launches for suppression of enemy air defenses.[6] Responding to indications and warnings of missile activity or intelligence reports, LOCAAS could be used to deny a capability before an adversary employs it against deployed forces or to preempt anticipated launches of residual missile capabilities.

MP-RTIP Acceleration/JSTARS Upgrades

The second and third recommendations also address mobile missile defeat, specifically the inadequate capabilities for mobile missile/TEL detection, tracking, and strike coordination. To enhance capabilities to perform these functions, the Air Force should accelerate MP-RTIP and upgrade the radar and data links on JSTARS.

The current MP-RTIP schedule (for engineering and manufacturing development) is not constrained by the pace of technological developments but by the funding supporting the program. With increased up-front funding ($300 million), MP-RTIP development could be accelerated by two years, leading to an initial operational capability two years earlier than currently anticipated: the first Global Hawks with the MP-RTIP GMTI/SAR sensor system would be available in FY2007 (versus FY2009) and the first manned platform in FY2008 (versus FY2010).[7]

In conjunction with the MP-RTIP acceleration, the Air Force should select JSTARS as the MP-RTIP manned platform and upgrade the JSTARS radar. Although the Air

Force has valid concerns regarding the JSTARS airframe[8] and the radar range of JSTARS is limited, several factors speak strongly for its selection. First, the JSTARS platform is the most expeditious manned platform path for fielding this capability, and without it mobile missile attack operations will be hampered by an inadequate number of wide area surveillance platforms in the mid-term. Second, due to its power, the JSTARS radar can provide greater resolution than the Global Hawk sensor system and this resolution may be critical for mobile missile identification in situations in which the missile vehicle seeks refuge close to other vehicles/objects or in dense vehicular traffic. Third, mobile missile attack operations would benefit from JSTARS battle management capability and if the aircraft were on station for battle management, it would reduce communication and data link requirements (and simplify operations procedurally) to collocate the detection and tracking sensor system on the same platform as the battle management function.

Second, to leverage the battle management capability of JSTARS for mobile missile attack coordination, the Air Force should immediately implement the JSTARS Link 16 upgrade—referred to as the Attack Support Upgrade (ASU). ASU would greatly improve JSTARS' digitized communication links, allowing it to pass target assignment, sorting, and track information directly to an attack aircraft's on-board systems. At the present time, JSTARS must rely primarily on voice communication link capabilities to direct attack aircraft to mobile targets. It is therefore unable to exploit fully even existing attack platform capabilities. For example, current data links from JSTARS to the F-15E allow for an estimated use of only 25-35% of the F-15E's mechanized capability to perform mobile target attack.[9]

As mentioned in Chapter 5, the good news is that the senior Air Force leadership is concerned about the data link deficiency. General John Jumper, ACC Commander and the Commander of United State Air Forces Europe during ALLIED FORCE, highlighted JSTARS data link deficiency at this past fall's Air Force senior leadership gathering (CORONA), but it is not yet clear whether funding will be made available for ASU. Jumper noted that the biggest problem in time critical targeting is that "JSTARS is not up to the task" and identified $68 million (FY2001-FY2004) as the sum required to accelerate ASU.[10]

Theater Airborne Warning System (TAWS)

The fourth recommendation—aimed at bolstering post-launch mobile missile TEL detection capabilities—is the installation of the Theater Airborne Warning System (TAWS) on the sixteen (16) RC-135 RIVET JOINT aircraft. TAWS is an optical surveillance sensor and data fusion system that would provide the warfighter with an ability to determine ballistic missile launch points more accurately and more rapidly than with the existing system and architecture.[11] Technology reports indicate that TAWS can reduce the current missile launch location ellipse error to 1/20th of its current size. TAWS also reduces the time required to identify and get launch point information to the attack assets from minutes to seconds.[12] This reduction in location error and notification time could significantly increase the probability of post-launch detection of a mobile missile TEL by attack assets.

TAWS is a USSPACECOM initiated project supporting theater missile defense that fuses data from existing airborne and space-based infrared sources, to provide low-cost, near-term improvements in missile launch location, position information of the missile in flight, and impact point. The data sources are a medium-wave infrared (MWIR) sensor currently deployed on the COBRA BALL RC-135 reconnaissance aircraft—the platform on which TAWS is currently installed—and the Defense Support Program (DSP) Satellites.[13] Funding for the demonstration and installation of TAWS on COBRA BALL has come predominantly through Congressional plus-ups and Congress has been a strong supporter of the program.[14]

The COBRA BALL fleet of three aircraft, however, is much too small to meet more than a contingency requirement. The Air Force should immediately transition TAWS to the RC-135 RIVET JOINT fleet (16 aircraft), the original platform of choice for this capability.[15] TAWS could be easily integrated with existing collection/warning operations and communication links of RIVET JOINT. Similar to JSTARS, as an element of the theater air control system, RIVET JOINT is likely to be on station early in a crisis, and is already connected to other battle management platforms via data links, voice channels, and broadcast systems. Thus, RIVET JOINT would be well equipped to provide missile launch warning and, more important for counterforce purposes, location data for TEL attack.

TAWS has been ready for fielding since 1997-98. As General Richard B. Myers, the Commander of U.S. Space Command at the time, told Congress in 1999: "TAWS can improve theater missile defense capabilities by putting more sensors on the mobile missile problem and could be fielded today if the funding were available."[16] TAWS has enjoyed the unwavering support of Congress[17] and U.S. Space Command, and now is picking up support from U.S. Central Command and U.S. Joint Forces Command. Further delays continue to deprive warfighters of an essential capability. Approximately

$70 million in additional funding would be needed to implement TAWS across the entire RIVET JOINT fleet, and at a rate of four aircraft per year, modifications and installations could be complete by FY2004.[18]

NBC/M Counterforce Planning and Execution Team

In addition to these four materiel advancements, an organizational adjustment is also urgently needed. In order to facilitate the development of a unified approach to NBC/counterforce—specifically, concepts of operations and operational plans that integrate the recently developed capabilities for NBC/M fixed target defeat with emerging capabilities for NBC/M mobile target defeat—DoD/Joint Staff should assign responsibility for NBC/M counterforce planning and execution support to a single Joint organization. This paper recommends that organization be the Joint Warfare Analysis Center (JWAC). The JWAC should create an "NBC/M Counterforce Planning and Execution Team," which would bring together the knowledge and tools associated with fixed facility targeting (CAPS, IMEA) with those associated with mobile targeting (TCT Cell concept and its associated tools). The team would serve as a vehicle for familiarizing commanders with NBC/M counterforce capabilities and a means to intellectually think through the issues associated with NBC/M counterforce operations.

The team's objective is to institute a more proactive approach to NBC/M counterforce. On the behalf of the warfighting regional Commanders-in-Chief (CINCs), the team would ensure: that intelligence and analytical work is undertaken well in advance of a potential conflict with a proliferator; and that warfighting plans effectively and efficiently integrate the various operational activities[19] into NBC/M counterforce operations in support of a CINC's NBC/M objectives. During a conflict, the team would provide reach-back support to an operations center that is conducting operations against a proliferator, monitoring an adversary's NBC/M operations and providing recommendations for the routine and real-time tasking and re-tasking of sensors and attack assets in support of NBC/M counterforce operations.

Ideally, the NBC/M Counterforce Planning and Execution Team would not be one team, but a team at each of the warfighting commands (located within, for example, the Air Operations Center). After all, the warfighting commands are responsible for developing and executing the warfighting plans in their regional areas. Arguably, they are also the most familiar with their own operational capabilities and the unique requirements of conducting military operations in their regions.

However, three considerations militate against this approach. The costs of creating six or seven versus one team are obvious. Less obvious are the operational inefficiencies and resource conflicts that might result from embedding a stand-alone team dedicated to a single type of operations with a multi-functional staff; the priority of NBC/M objectives in a campaign may not always justify resources dedicated exclusively to NBC/M counterforce operations. Perhaps the most important consideration are expeditionary requirements. Placing the team within the operations center of the warfighting command would substantially increase the personnel and hardware footprint of the operations center during a time when the U.S. military needs to emphasize organizational concepts that reduce the deployed physical presence of its forces, and hence their vulnerability. To support expeditionary requirements, operations center personnel should be familiar with counterforce issues, tools, and operational requirements but reach back for substantive support to a team in a permanent location.

If the team is to be a reach-back capability, several factors make the JWAC an attractive selection. First and foremost, are the tremendous intelligence and technical information and analytical resources already present that the team could draw upon. Second, is the experience JWAC already has in supporting the planning and execution of military operations for the warfighting commands. Third, JWAC's joint center status would likely eliminate any potential political concerns that the warfighting CINCs might have had concerning another CINC's direct involvement in their operations, had the team been assigned to a specific CINC.[20]

Notes

[1] U.S. Department of Defense, Office of the Secretary of Defense, *Proliferation: Threat and Response* (Washington, D.C: GPO, 1997), p. 2.

[2] For example, another prime candidate for this list is the TESSA Synthetic Aperture Radar for the F-15E. A tactical ground SAR such as TESSA may enhance a pilot/weapon system officer's ability to discern a TEL from a decoy and aid in individual target identification/assignment when there is more than one TEL and strike platform in the target area. However, details on TESSA SAR performance were not available, nor was information on a possible ATR upgrade, nor were reliable cost data. The F/A-18E/F active electronically scanned array radar (AESA radar; IOC 2006) may provide the same capability. The Air Force and Navy have experimented with a tactical SAR radar in a podded installation (the APG-76 used on Israeli F-4s) that produces small SAR/GMTI spot maps useful for TEL identification. See Mark Hewish and Joris Janssen Lok, "Stopping the Scud Threat: Engaging Theater Ballistic Missiles on the Ground," *Janes's International Defense Review*, vol. 30, no. 6 (June 1997), pp. 40-47; "Sea STARS May Give Navy Organic Ground Surveillance Capability," *Inside the Navy*, vol. 9, no. 22 (June 3, 1996), on-line, internet, March 22, 2001, available from http://www.infowar.com/iwftp/c4i/archvol2/v02.n385.txt.

[3] The Joint Air to Surface Standoff Missile (JASSM) is also frequently mentioned as mobile target weapon due to its infrared imaging seeker and "general pattern match-autonomous target recognition system" that provides aimpoint detection, tracking and strike during the terminal guidance phase. This, too, is at best a relocatable target capability, for JASSM requires extensive mission planning of a preprogrammed target.

[4] Potential delivery platforms (and loadouts) for LOCASS include: F-16 (16 LOCASS); F-15E (48 LOCASS); F-117 (16 LOCAAS); F/A-18 E/F (16 LOCAAS); F-22 (16 LOCAAS); JSF (16 LOCAAS); B-52 (96 LOCAAS); B-1 (120 LOCAAS); and B-2 (136 LOCAAS). Contractors are also exploring placing LOCAAS on Predator and integrating it into the Wind Corrected Munitions Dispenser (WCMD—4 LOCAAS) and

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into the JASSM (3 LOCAAS). Technology reports also indicate that consideration is being given to incorporating LOCAAS into UCAVs such as the Boeing X-45A for SEAD/DEAD missions as well.

[5] There were forty-two such occurrences in DESERT STORM. See Fulghum, "Cobra Ball Revamped."

[6] Unlike the HARM, which has displayed a tendency to go "ballistic" if it does not find a target (experienced most recently during ALLIED FORCE), LOCAAS can be programmed to safely self-destruct. In the final minutes of its flight—if LOCAAS has not found one of it pre-programmed, prioritized targets—it could fly up to a safe altitude (or to a pre-programmed safe area) and self-destruct. Self-destruction eliminates unexploded ordnance and reduces the possibility of technology compromise.

[7] All five manned platforms would be operational by FY2010 (versus 2012).

[8] While several further investments are required to keep the aircraft and its systems at a high state of operational readiness, re-engining of the fleet stands out as critical requirement. Re-engining would allow for operation from shorter runways and faster climb to higher operational altitudes. This would increase sensor coverage, decrease terrain masking of sensors, increase on-station time, increase communications reach, and improve survivability of the aircraft. Re-engining of the JSTARS fleet is currently unfunded.

[9] Jumper, "Link 16."

[10] Jumper, "Link 16."

[11] TAWS consists of a optical sensor system (a medium wave infrared (MWIR) sensor developed by Textron and known as MIRA—Medium Wave Infrared Array) with its laser rangefinder, satellite data fusion systems, and communications systems. The existing missile warning system architecture includes the Air Force Attack and Launch Early Reporting to Theater (ALERT), Army/Navy Joint Tactical Ground Station (JTAGS), and the Navy's Tactical Detection and Reporting (TACDAR) systems. These systems provide warning of theater ballistic missile launches to active missile defense systems and deployed forces, and missile launch location data for attack operations.

[12] Fulghum, "Cobra Ball Revamped;" David A. Fulghum, "Endurance, Standoff Range Remain Crucial Attributes," *Aviation Week and Space Technology*, vol. 147, no. 5 (Aug. 4, 1997), pp. 51-53; and David A. Fulghum, "Multi-Sensor Cobra Ball Tackles Missile Defense," *Aviation Week and Space Technology*, vol. 147, no. 5 (Aug. 4, 1997), pp. 54-57.

[13] MIRA provides recognition of missile launches within seconds of launch. Some delay may result if the sensor must wait for the missile to break cloud cover but horizon clearance is not an issue within its 250nm range. Since theater ballistic missiles generally burn for approximately 30 seconds until engine cut-off, cloud cover (weather) only marginally degrades system responsiveness Department of the Air Force, SAF/AQI, "Point Paper on the Theater Airborne Warning System," January 1, 2001 and U.S. Department of the Air Force, Headquarters USAF/AQIJ, "TAWS," briefing, n.d. TAWS will access and use data from DSP's replacement—the Space Based Infrared System (SBIRS)—when SBIRS becomes operational. See Eberhart, "Statement."

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[14] See Myers, "Testimony."

[15] During DESERT STORM, for example, two RIVET JOINT orbits were required to maintain coverage over the entire area of responsibility. Four aircraft (minimum) would be needed to maintain these two orbits 24 hours a day.

[16] Myers, "Testimony."

[17] One poignant example of Congressional support over the years: "… the conferees urged the Air Force to proceed with a program to install TAWS on the Rivet Joint RC-135 aircraft, which is available in greater numbers than the Cobra Ball. Such a program would provide an option for early deployment of TAWS in support of improved theater ballistic missile defenses. However, the Department has opted instead to install this capability on the Airborne Laser (ABL). The committee understands that the ABL is not scheduled to reach initial operational capability until 2003 [*sic*]. The long intervening period during which TAWS would remain only on the very few Cobra Ball aircraft would not meet the near-term need for a theater ballistic missile analysis and warning capability. Furthermore, the Air Force plans to acquire no more than seven ABL aircraft, a force structure too small to assure that TAWS would be available when and where needed. The committee believes this important mission is best satisfied by a reconnaissance aircraft. Therefore, the committee recommends an increase of $20.0 million to migrate the MWIR TAWS technology from the Cobra Ball RC-135 to the Rivet Joint RC-135 to enhance near-term deployment flexibility." U.S. Cong., House, Committee on National Security, "National Defense Authorization Act for Fiscal Year 1998: Report of the Committee on National Security on H.R. 1119," June 17, 1997, online, internet, January 12, 2001, available from http://www.fas.org/man/congress/1997/ h_rpt_105_132r_ed_acq.htm.

[18] SAF/AQIJ, "Point Paper."

[19] *E.g.*, surveillance/reconnaissance, SOF operations, fixed site attack, interdiction/area denial, preemptive NBC/M counterforce sweeps, NBC/M counterforce combat air patrol, and mobile missile strike.

[20] Otherwise, STRATCOM, for example, also would have been a good candidate the team, given its nuclear planning experience and expertise and the fact that it houses CAPS.

Chapter 7

Summary

This paper has presented an argument for an immediate conceptual focus on and resource commitment to NBC/M counterforce, maintaining that NBC/M counterforce operations will be essential to preserving the ability of the U.S. to project military power and successfully prosecute operations in the near- to mid-term. An immediate focus and commitment are essential because the potential contributions of NBC/M counterforce operations remain poorly understood and undervalued, as does the urgent need for NBC/M counterforce capabilities.

The strategic context for U.S. military operations in the near- to mid-term suggests that the U.S. military should embrace a more expansive view of the range of counterforce operations that it may be called upon to perform. Adversaries will likely use NBC/M capabilities to deny U.S. forces geographical access to areas of conflict. Commanders may find themselves conducting counterforce operations independent of ground force employment or other military operations—for example, in response to NBC/M attacks against civilian targets that prove impossible to effectively shield with active defense systems or in punitive response in manner similar to Operation INFINITE REACH.

The need for robust NBC/M counterforce capabilities is urgent. As illustrated by the existing and expanding NBC/M capabilities of proliferators/potential adversaries in the

Middle East, the NBC/M threat menaces U.S. allies, deployed troops, and abilities to conduct expeditionary operations in the region in defense of its interests and allies. Nor is the U.S. the TMD active defense shield likely to provide an effective response to the NBC/M threat in the near- to mid-term. The TMD Family of Systems will not be able to deliver the defense capability that it was designed to provide for almost another decade, even under the most optimistic acquisition timelines.

Progress to date in fielding an effective NBC counterforce capability has been significant—considering the relatively low priority and modest resources that DoD has committed to counterforce—but critical capabilities gaps remain to be filled. Most acute are those relating to NBC agent defeat and mobile missile attack. While agent defeat appears to require more long-term solutions, restructuring and relatively modest- to intermediate-sized investments in select mature programs could significantly enhance our NBC/M capabilities in the near-to mid-term. This paper recommends five: LOCAAS program acceleration; MP-RTIP acceleration; JSTARS radar and data-link upgrades; the installation of TAWS on the RC-135 RIVET JOINT fleet; and the establishment of an NBC/M counterforce planning and execution team at the Joint Warfare Analysis Center.

Appendix A

Department of Defense Counterproliferation Areas for Capability Enhancements for 2000

In priority order:

1. Enable sustained operations in an NBC environment through decontamination and individual and collective protection (7.7%)
2. Detection, identification, characterization, and warning of CBW agents (4.8%)
3. Medical protection against NBC agents, to include vaccine stockpile availability (1.1%)
4. Collection, analysis, and dissemination of actionable intelligence to counter proliferation (0.6%)
5. Ballistic and cruise missile active defense (72.1%)
6. Support for Special Operations Forces and defense against paramilitary, covert delivery, and terrorist NBC threats (2.0%)
7. Target planning for NBC/M targets (1.1%)
8. Detection, characterization, and defeat of hard /or deeply buried targets with minimal collateral effects (0.3%)
9. Detection, tracking, and protection of NBC/M and NBC/M-related materials and components (0.1%)
10. Detection, characterization, and defeat of NBC/M facilities with minimal collateral effects (1.0%)
11. Prompt mobile target detection and defeat (0.0%)*
12. Provide consequence management for terrorist use of NBC weapons (including civil support in response to domestic WMD contingencies) (1.4%)
13. Support export control activities of the U.S. government (<0.1%)
14. Support inspection and monitoring activities of arms control agreements and regimes and other nonproliferation initiatives (7.7%)

Figures in parenthesis indicate percentage of DoD FY2001 Counterpoliferation Investment

*Included in ACE 4, 5, 6, 7, and 8

Glossary

ABL	Airborne Laser
ACE	Area for Capability Enhancement
ACTD	Advanced Concept Technology Demonstration
ADW	Agent Defeat Weapon
AESA	Active Electronically Scanned Array
AFDD	Air Force Doctrine Document
ASU	Attack Support Upgrade
ATACMS	Army Tactical Missile System
ATR	Automatic Target Recognition
AUP	Advanced Unitary Penetrator
BAT P^3I	Brilliant Anti-Armor Pre-Planned Product Improvement
BIAM	Bomb Impact Assessment Modification
BM/C3	Battle Management/Command, Control, and Communications
BMDO	Ballistic Missile Defense Office
CALCM	Conventional Air-Launched Cruise Missile
CAPS	Counterproliferation Analysis and Planning System
CEP	Circular Error Probable
CINC	Commander-in-Chief
CPI	Counterproliferation Initiative
DoD	Department of Defense
DSP	Defense Support Program
DTRA	Defense Threat Reduction Agency
ERGM	Extended Range Guided Munition
FoS	Family of Systems
FY	Fiscal Year
FYDP	Future Years Defense Program
GEM	Guidance Enhanced Missile
GMTI	Ground Moving Target Indicator
GPS	Global Positioning System
HARM	High-Speed Anti-Radiation Missile
HDBTD	Hard and Deeply Buried Target Defeat Program
HPAC	Hazard Prediction and Assessment Capability
HTSF	Hard Target Smart Fuse
IMEA	Integrated Munitions Effectiveness Assessment
IOC	Initial Operational Capability
ISR	Intelligence, Surveillance, and Reconnaissance
JASSM	Joint Air-to-Surface Standoff Missile

JDAM	Joint Direct Attack Munition
JTAMDO	Joint Theater Air and Missile Defense Office
JEFX	Joint Expeditionary Force Experiment
JSF	Joint Strike Fighter
JSTARS	Joint Surveillance Target Attack Radar System
LADAR	Laser Detection and Ranging
LANTIRN	Low Altitude Navigation and Targeting Infrared System for Night
LASM	Land Attack Standard Missile
LOCAAS	Low Cost Autonomous Attack System
MEA	Munitions Effectiveness Assessment
MEADS	Medium Extended Air Defense System
MIRA	Medium Wave Infrared Array
MLRS	Multiple Launch Rocker System
MP-RTIP	Multi-Platform Radar Technology Insertion Program
MTI	Moving Target Indicator
MWIR	Medium Wave Infrared
NBC	Nuclear, Biological, Chemical
NBC/M	Nuclear, Biological, and Chemical Weapons and Theater Missiles
NSFS	Naval Surface Fire Support
NTW	Navy Theater Wide
P^3I	Pre-Planned Product Improvement
PAC	Patriot Advanced Capability
PGM	Precision-Guided Munition
RPV	Remotely Piloted Vehicle
RTIP	Radar Technology Insertion Program
SAM	Surface to Air Missile
SAR	Synthetic Aperture Radar
SBIRS	Space-Based Infrared System
SEAD/DEAD	Suppression/Destruction of Enemy Air Defenses
TAWS	Theater Airborne Warning System
TBM	Theater Ballistic Missile
TCT	Time Critical Targeting
TEL	Transporter Erector Launcher
THAAD	Theater High Altitude Air Defense
TLAM	Tomahawk Land Attack Missile
TMD	Theater Missile Defense
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Aerial Vehicle
USSTRATCOM	U.S. Strategic Command
WAS	Wide Area Surveillance
WMD	Weapons of Mass Destruction

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